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Training Factory Foremen

By Ellis G. Fulton

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A brief history of the growth and extension of foremen training by means of the conference idea is given. The method of approach, the selection of the text, and proper leadership all influence the final result

APROPOS of the wide attention that the subject of foremen training has recently received in periodicals and conventions, the experience of the Extension Division of the University of Wisconsin may be of some interest. Although work of this sort had been attempted in a limited way by a few individual organizations, it was not until the winter of 1922 that this University first brought its extension work into this field. The results obtained were more than satisfactory and soon led to other "conferences" of groups of wide diversification where success was also attained. The University authorities are now urging the adoption of similar educational effort outside of the State. This idea should not meet with many obstacles since public funds may now be used for training teachers of those engaged in industry under the Smith-Hughes and Vocational Rehabilitation Acts either through the state departments of vocational education, or through the local boards of education.

In Wisconsin in 1919 there were 520 manufacturing plants operating with more than 100 employees each. Every one of these plants had drawn freely upon technical and business schools and training courses for executive and engineering talent. In every city of 5,000 or more persons the state law required that vocational training be offered the workers. A man could study through a multitude of channels to be a mechanic, a draftsman, an engineer, a lawyer, an accountant, an executive, but nowhere, before 1921, could he study to become a better foreman.

The industrial need of foremen training was emphasized and the means of supplying it suggested by the war. Dean Louis E. Reber, at that time director of education and training of the Emergency Fleet Corporation, U. S. Shipping Board, helped to create and saw the results of the training courses supplied to workers in the various shipyards engaged in war production. Returning to Wisconsin after the armistice, he saw in the University Extension Division the machinery for similar training adapted to the needs of peace-time industry and offered the idea to local manufacturers.

The pioneer course was started at the plant of the Parker Pen Co. of Janesville, Wis., in co-operation with George W. Gilman, production manager. In opening this course two important factors had to be solved, the one being a matter of proper leadership, the other the text material to be used. Glenn Lion Gardiner, at that time employment manager of the Chevrolet Motors Co. was the man selected. He had the necessary vision and educational background, together with a practical knowledge of the industry. Mr. Gardiner guarded against the flavor of a school room and instead made the meetings truly conferences wherein he largely acted as chairman of the discussions which arose from the text. He avoided "highbrow" language and obscure theory and tried rather to discuss the foreman's everyday problems in the simple language of the shopmen. This policy proved very fruitful.

In preparing the text the Extension Division was guided by the type of men being approached and wrote accordingly. Foremen are men of mature minds, inclined to be skeptical of courses and to scoff at theory. They are largely self-made men with the confidence that comes of making their own way in the hard school of industrial competition. Most of them have never carefully analyzed their jobs. They learn by trial and error and rule of thumb methods. They are not open-minded. They think best and are most interested when challenged. They enjoy discussing their own problems. They are naturally loyal. They have a high regard for the square deal and will co-operate with a man in whom they have confidence.

Most foremen are well up on the technical side of their jobs through the long experience which has earned them their promotion. They are not well fitted, however, to meet the human problems that confront even a minor executive. Hence the first chapter of the text was "Handling Men." Other chapters discussed industrial good will, employment management, selecting men for jobs, wage problems, advantages of increased production, and the like. When the fundamentals had been mastered more advanced subjects such as selling

problems, purchasing, material stock-keeping, traffic problems, design and research, accounting and other general topics were brought up for discussion. In every case highly technical details were omitted and simple, concrete examples were used as often as possible to bring out each point.

The benefits which accrued to the Parker Pen Co. soon became known and led to the formation of other groups, notably the one at Appleton. This particular group affords a good illustration of the method by which classes were started. Members of the staff of the Extension Division, working in close co-operation with the officers of the seven principal industries, organized a group of thirty-five men, and secured as chairman, J. Davis, employment manager of the Paine Lumber Co. from the neighboring city of Oshkosh. Mr. Davis' personality and enthusiasm is still spoken of by members of the first group as the outstanding feature of the course.

Material and suggestions for conducting the discussions were supplied by the Division, which also corrected and returned the written reports which most of the men made covering the meetings and the corresponding pamphlets. The cost of the course was paid, in some plants, wholly or partially by the company, in others by the men themselves. In nearly every case the company refunded part or all of the tuition of the men who completed the courses.

The pamphlets used were reprints of single chapters in the Extension Division books *Practical Foremanship*, and *Management in the Factory*. Large type and simple, straightforward language that foremen can easily read and understand are featured. They are close enough to each man's everyday job to interest him and broad enough to be used in any plant without interference with established policies of management. They were designed, moreover, to be highly suggestive of discussion from the man's own experience. The pamphlet form was adopted to permit the men to carry them in their pockets for reading at odd times. At each meeting the pamphlet for the next meeting was distributed, so that men could come prepared to enter into the discussion.

It was found that the time and place of holding meetings had an important bearing on the success of these foremen conferences. Better attendance, a feeling that the company is behind the project, and that it is really a part of the job are some of the advantages that resulted from holding conferences on company time. Morning hours usually found the foremen's minds fresh and ready. On the other hand, where production was likely to be disturbed by taking foremen away for meetings on company time, some groups of foremen felt more interest in the course when they sacrificed their own time. Where possible the place chosen was away from the noise of machinery and free from the intrusion of outsiders. All suggestion of the schoolroom was avoided. An ideal arrangement, used in the Appleton conferences, was a large assembly room in which was a round table seating thirty to forty men. A portable blackboard stood just behind the chairman; everyone could see it and everyone else at the table. Smoking was permitted and even encouraged.

Another excellent plan was for the company to "set-up" dinners to the foremen at a convenient hotel or at the company cafeteria, if one was available. After a good dinner and a smoke the men were refreshed and in a genial frame of mind which proved the best stimulus to profitable discussion and good feeling all around.

In order to continue the opportunity for discussion and exchange of ideas such as was obtained during the regular course, the Appleton Foreman's Club was organized "to educate and to promote a closer unity and fellowship among its members," as its constitution reads.

None of the executives in Wisconsin plants where foremen conferences have been held could measure the results in terms of definite money value. Foremen training is no panacea for all industrial ills. Each executive, however, had some particular weak spot in his organization that he hoped to strengthen by introducing the course, and each executive found that such training improved not only these particular conditions but also other conditions to which no thought has been given.

The list which follows is a composite of the effects of foremen training, as reported by the various executives who have so far co-operated with the Wisconsin Extension Division in presenting courses:

Friction within departments and between different departments eliminated.
Cost of labor turnover reduced.
Labor troubles practically absent.
Accidents reduced, due to better supervision and instruction of workmen.
Waste of time and material reduced.
Quality of product improved.
Better co-operation between production and accounting and materials stores departments.
Production per man increased.
Better *esprite de corps* throughout the entire organization.

The value of results such as the above is so obvious and tangible, that no further argument should be required to convince the thinking executive that the adoption of foremen training is well worth while.

Ten Safety Hints

Calendars for 1926, just issued by the general safety committee of the General Electric Co., carry ten safety hints. The calendars are the usual pocket-size cards with rounded corners and carry six months on each side. Alongside the calendar figures are these safety hints, five on each side of the card:

1—General Electric has a good record in accident prevention, but wishes to improve it. Let us all help.

2—Be sure to go to the Dispensary in case of injury, no matter how slight.

3—Two good eyes are all you'll ever get. Save 'em.

4—A Safety tip—Don't slip.

5—Success is a habit. So is Safety.

6—Cleanliness and order, and a place for everything, are essentials of Safety.

7—All wires should be considered as alive.

8—The best safety device known is a careful man.

9—Most accidents are someone's fault. Don't let them be yours.

10—Safety is contagious—be sure you catch it.

Absolute interchangeability is rarely found and seldom justified. For selective assembly, using parts previously graded, gives an equally good product and generally at a lower cost. In absolute interchangeability, the rejection of parts is necessarily much higher than with selective assembly.

Automotive Production

Willys-Knight Production Methods

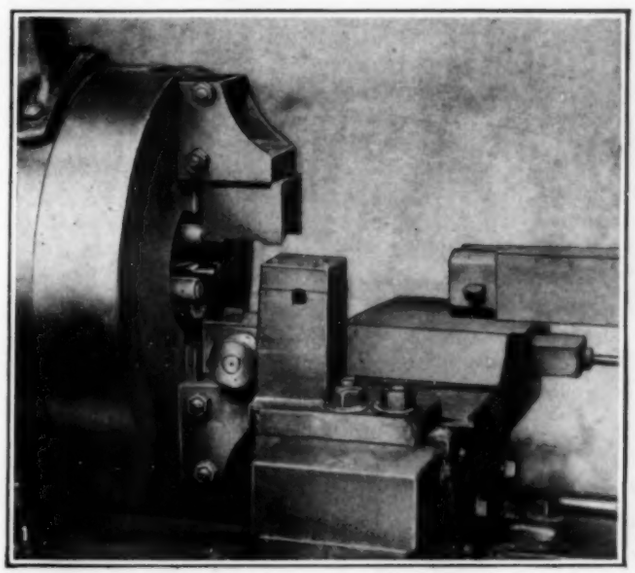
By Fred H. Colvin
Editor, *American Machinist*

Standard methods, with a few variations as to operations, mark the making of the pistons for the Knight motor—Individual rings are ground automatically

Pistons and Piston Rings

PISTON manufacture has many operations that are nearly standardized. In almost every case, the first operation is to bore and face the open end of the skirt to form the locating point for future operations. In the Wilson Foundry, the boss on the solid end of the piston is drilled and countersunk at the same time by means of the center drill shown inside the chuck in Fig. 1. The combination center drill is fed through the hollow spindle of the lathe while the open end of the piston is being bored. The solid end of the piston is located against the three stops that surround the center drill. The shape of the chuck jaws is such as to distribute the pressure of chucking. The squareness, concentricity and size of the open end are so important that the first operation is followed by a second, in order to remove any inequalities that might result because of the springing of the wall after the roughing cut.

Boring the piston-pin holes is the next operation, in order to give a means of holding the piston while turning the outside and facing the head. The rough drilling is done on the special Foote-Burt machine shown in Fig. 2. Two pistons are drilled simultaneously. An indexing fixture and four drills are used. Two pistons in each end of the fixture, and the drills feed from above and below, each pair of drills drilling half-way through one piston. Substantial bearing points are provided, as at *A* and *B* to prevent deflection of the fixture under the pressure of the drills. The necessity for having the holes parallel with the faces of the pistons, warrants all precautions that can be taken, and is the reason for rough and finish boring and reaming. The pistons are located in the fixture by both the bore and face of the open ends, and are held by clamps at the outer end. The outside of the piston is turned on a Cleveland



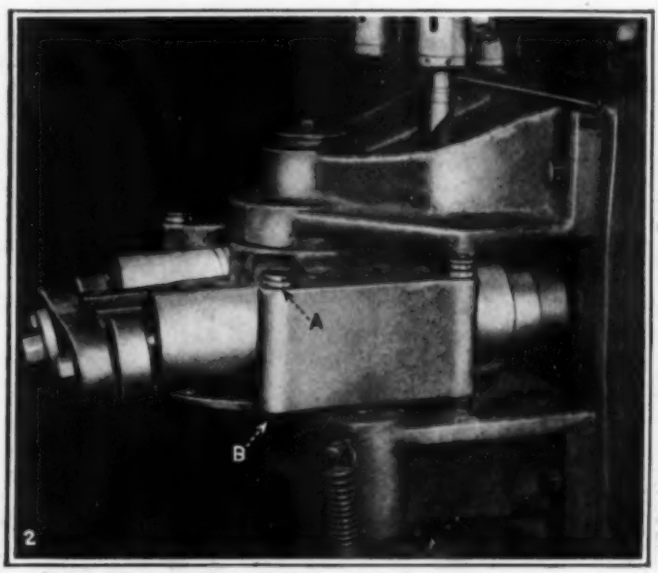
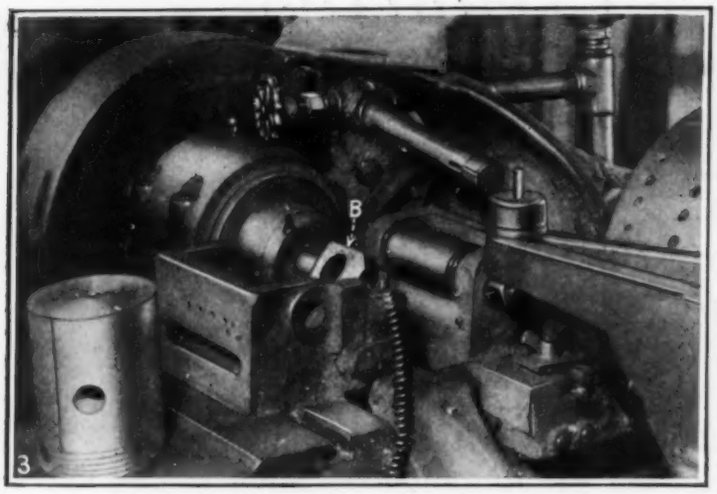
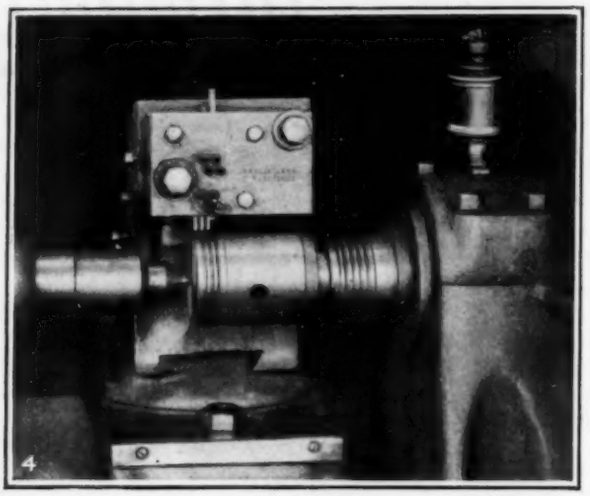
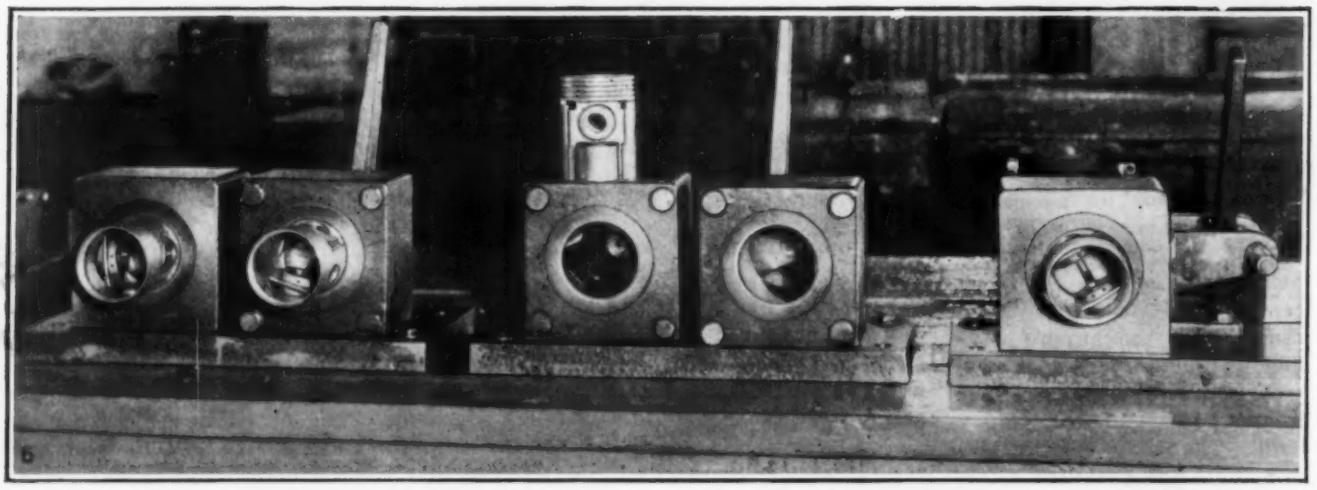


Fig. 1—Chuck and tools for first operation on pistons. Fig. 2—Drilling piston-pin holes

Automotive Production







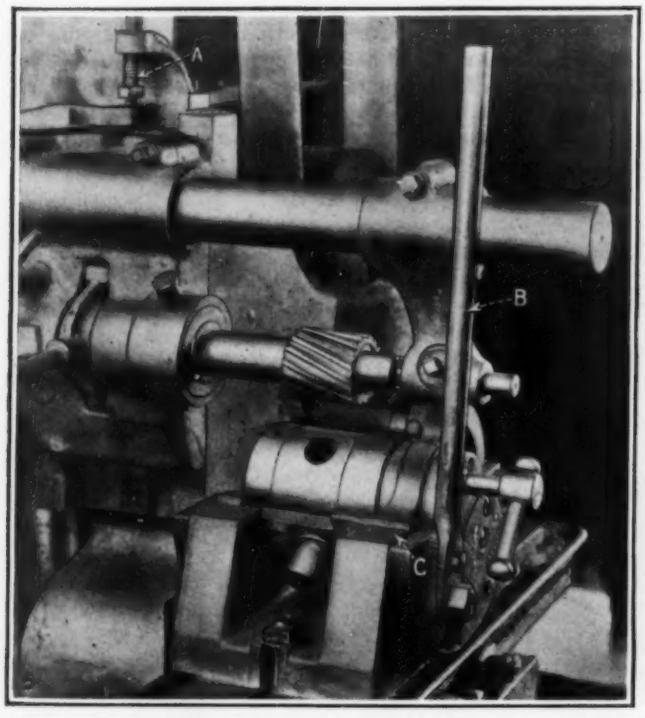
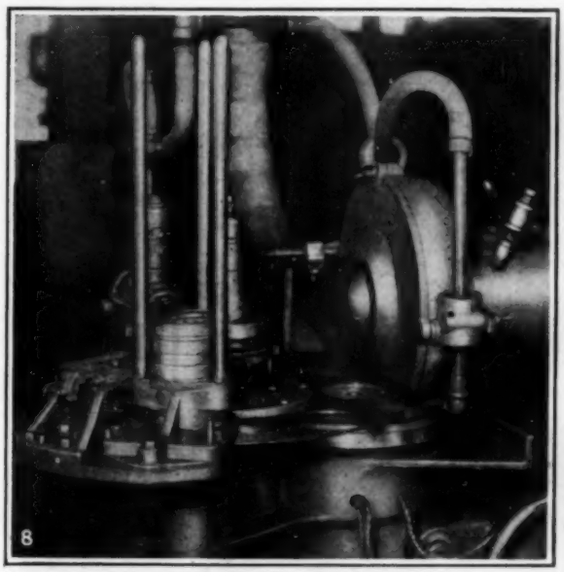


Fig. 3—Turning in the automatic. Fig. 4—The grooving tools. Fig. 5—Relieving the sides. Fig. 6—Gages with ejectors. Fig. 7—Rough grinding piston rings

Automotive Production



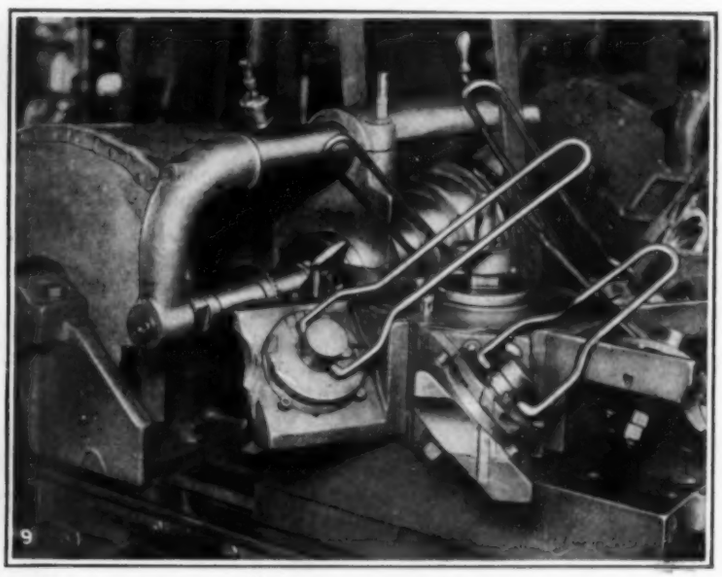


Fig. 8—Finishing ring on automatic grinder. Fig. 9—Fixture for slotting rings

automatic as in Fig. 3. The piston is located on the chuck *A*, and a short pin is put through the piston-pin holes and through the eye *B* of the drawbolt. The drawbolt is operated by an air cylinder on the end of the spindle. This operation includes facing the head of the piston.

Cutting the ring grooves and reducing the diameter behind the lower ring, is done by the tools shown in Fig. 4. Each tool is held by two headless setscrews, the piston being driven by an eye bolt and short pin as before. The finish turning of the piston and of the head, follows the cutting of the ring grooves. The relief is cut at the ends of the piston-pin hole, on the Kent-Owen machine shown in Fig. 5. The piston is located by the open end, as usual, and clamped by the end screw shown. The cutter is fed down, the proper depth being regulated by the adjustable stop at *A*, and the piston is then partly revolved by means of the lever *B* in connection with segmental gears shown. The fixture rolls on substantial trunnions that are larger than the piston, as shown at *C*.

The outside of the piston is finished by grinding, after which the piston-ring lands are undercut and chamfered. The piston-pin hole is then rough reamed, this operation being followed by a reaming to size. In aluminum pistons, the hole is reamed 0.003 in. below finish size.

Another type of piston is shown in Fig. 6, together with the five gaging blocks by which the pistons are sorted into five sizes before going to the assembly department. A feature of these gages is the use of an ejector to push the piston out of the gage after inspection. The ejector is simply a lever-operated pin that bears in the center of the piston head. An ejector of different design is shown at the right.

Piston rings may, perhaps, be divided into two types—those cut from the cylinder, or "pot," and those cast individually. There is a further difference, in that with the individually cast ring, the inside of the ring is not machined, the skin or scale being left on to give stiffness, or tension, somewhat similar to that secured by hammering.

The rings made by the Wilson Foundry & Machine Co. are cast individually and the first operation is to rough grind both sides on a double-head Gardner machine, in which the two disks are offset, as in Fig. 7. The rings are placed in the revolving plate *A*, and pass between the two abrasive disks, being ejected into the chute as shown. Then the rings go to the Heald grinder equipped with an automatic, magazine feed, as shown in Fig. 8, for finish grinding the sides. The rings are piled in a stack and carried under the wheel by the dial feed. When in position, the current is automatically turned on the magnetic chuck, and the rings are revolved under the wheel for the necessary length of time. The current is then shut off and the dial feed then indexes, carrying the finished ring off and putting a new one on the chuck.

Slotting the rings is accomplished on the milling machine shown in Fig. 9, in which an unusual feature is a six-sided turret having a ring holder in each face. The rings are placed on the angular surface, the clamping plates with their hairpin handles placed over the

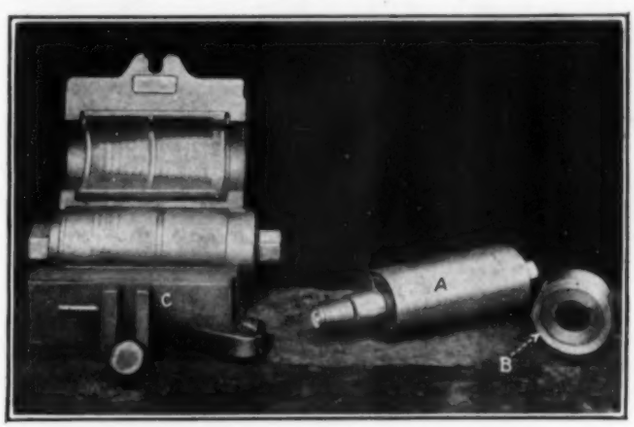


Fig. 10—Mandrel for grinding rings

Automotive Production

rings and locked in place, and the table automatically feeds the rings against the cutter. In this way the rings are handled rapidly, and the equipment cost is not high. The mechanism for moving the turret slide is at the left of the table.

The slotted rings are next slipped over the mandrel *A*, Fig. 10, the end plate *B* being placed on the mandrel, but not tightened. Then the loaded mandrel is placed in the aligning fixture *C*, and the cover lowered and clamped to make the rings close concentrically on the arbor. The end plate is then clamped against the rings by the nut, and the rings thus mounted are ready to be turned and ground in the usual way. The rings do not leave the mandrel until they have been ground to the proper size.

Special Fixtures for Milling and Boring

The use of special heads on milling machines to adopt them to particular operations is receiving favorable attention in automotive shops. A number of these heads are in use in the shops of the Rickenbacker Motor Car Co., Detroit, and one is shown herewith. A few other interesting fixtures are also shown.

Special heads on knee-type milling machines are used on a number of operations, one being shown in Fig. 1, where the upper surface of the oil pan is being machined by the two end mills shown. The milling head, with its two vertical spindles, is driven from the main spindle of the LeBlond milling machine, and when not in use the head can be swung up out of the way, as in Fig. 2. In clamping the oil pan, care is taken not to spring it by the clamping screws, the jacks *A*, Fig. 1, being used for the purpose. The jacks are made of hex stock and are screwed against the side walls before the clamping screws are applied.

The ends of the crankcase are milled on the same machine as shown in Fig. 2, by swinging the special cutter-head up out of the way and using a large face milling cutter on the machine spindle. As can be seen, this fixture is very simple.

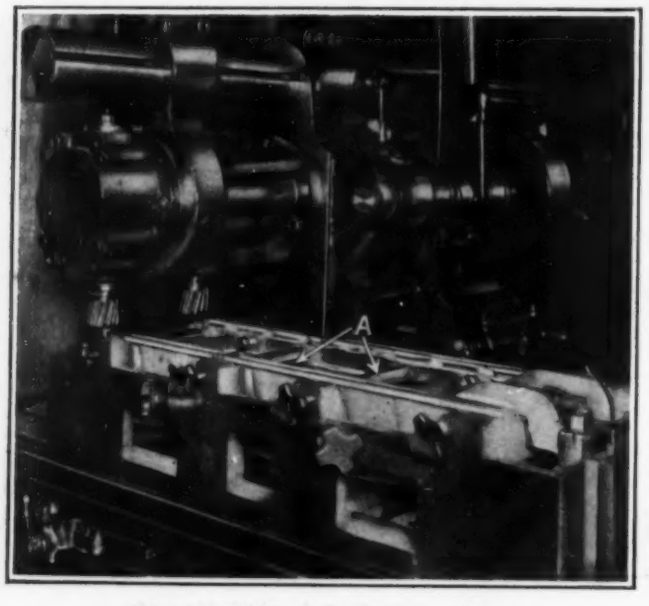


Fig. 1—Milling the joint surfaces

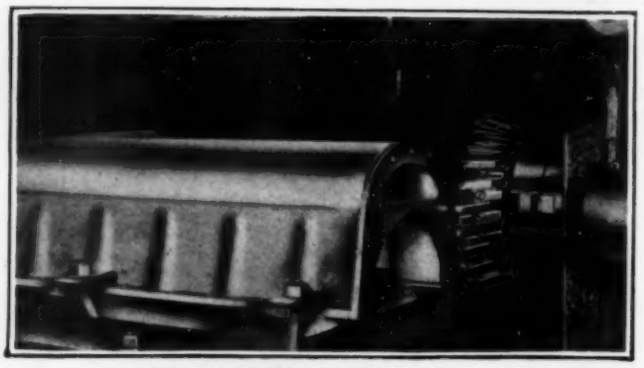


Fig. 2—Facing end of oil pan

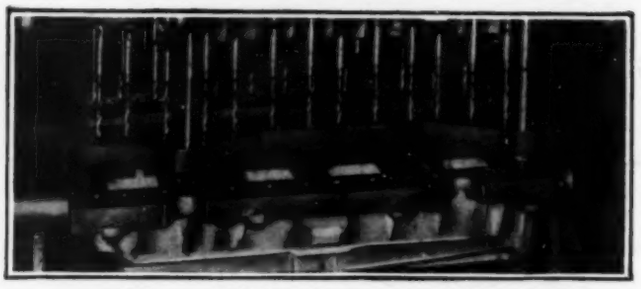


Fig. 3—Drilling fixture for oil pan

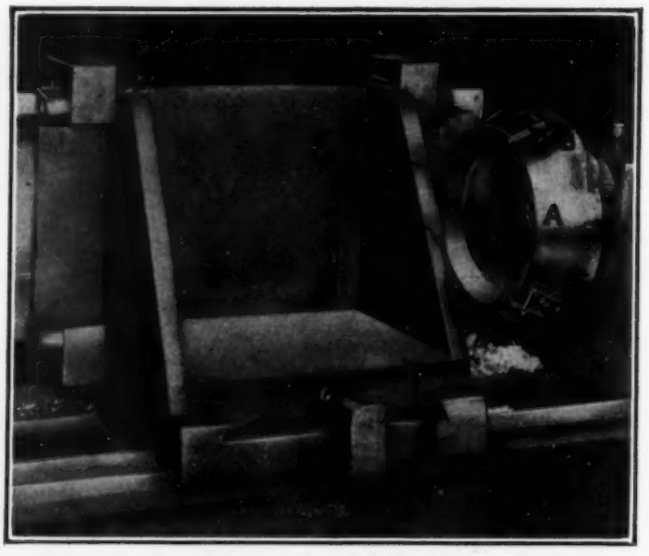


Fig. 4—Boring end of oil pan

The oil pan is drilled in the Natco machine shown in Fig. 3. This view shows the way in which the work is held in the roll-over fixture and also the design of the bushing plate. Still another simple fixture used in boring the ends of the oil pan is shown in Fig. 4. The pan is held against the angle plate by the clamps shown and the work is fed against the large cutter *A*. The cutter head carries three tools, two of which are shown at *B* and *C*. A lathe that would be of little use in other operations in an automobile shop, is used for the operation.

Modern Tooling Methods for Turret Lathes

By M. E. Lange
Production Engineer, the Warner & Swasey Co.

Variety of pieces greater in chucking work than in bar work — Uses of the adjustable-angle cutter holder—Examples of work requiring two chuckings

THE aim in writing this series of articles is to suggest better methods of increasing production of both small- and quantity-lot work, with a clear recognition of the limitations of tool cost in both production fields.

The purpose of this chapter is: First, to emphasize the increase in production possible through the application of the principles of combined cuts, multiple cuts, and rigid tooling. The examples in this section are generally larger and more complicated in nature than those shown in the previous section on chucking work, and attention is given both to small- and quantity-lot production. Second, to illustrate with actual examples how an exceedingly wide range and variety of chucking work can be handled with one low-priced set of universal tooling equipment. Such equipment is made on a manufacturing basis, and can be furnished by the maker of the machine.

Production engineers have evidently taken a leaf from Herbert Hoover's note book on simplified practice. A variety of work is now done on turret lathes using standard equipment, that formerly would have required a number of expensive special tools

Since the variety of types and kinds of pieces made in chucking work is greater than in bar work, the chapter, on reducing the tool cost, will suggest two slightly different types of chucking equipment, the plain set and the overhead-piloted set. The exact equipment in each set will be clearly shown, and the field of work for which each set is best suited will be carefully defined. Then the permanent set-up of this equipment will be treated, showing how the set-up time for changing from job to job is reduced. A careful study will also be made of the exact groups of work which can be produced on each of the two types of chucking equipment.

In the last chapter, The Final Question, a definite comparison will be made of the increased production and the cost of universal tooling equipment, so that the reader may quickly find the answer to his own individual problem of tooling cost.

Although the cuts on the aluminum cover shown in Fig. 144 are light, aluminum can be machined at speeds from 400 to 700 ft. per min. This work requires as much power in the head at high cutting speed as when cast iron is turned at low speeds. Therefore, it is necessary to provide a machine having ample power, so that an 18-in. geared, friction-head turret lathe of the ram type, as illustrated in Fig. 146, is used.

The tools in the universal set, as shown in Fig. 145, are designed for quick adjustment to different jobs. The rough boring cuts are taken by the multiple-cutter head at I, which holds forged cutters of standard shapes that can be quickly adjusted. The finish-boring cutter is a plain bit held in an adjustable-angle cutter holder at II. This tool is mounted in the regular multiple-turning head and can be quickly and accurately set to size by a graduated dial. The finishing cutter for the rim is held in the vertical-slide tool at III. The inner face of the recess and the rim are rough faced with the same cutter that rough bores the inside diameter of the rim at I, so this cutter is ground square on its cutting edge. Since the inner face must be accurately squared, the cutter in the slide tool, which finish bores the rim, is also used for the accurate facing operation. The large micrometer dial and its clips for setting, assure quick adjustment of the tool for finish boring. The other tools in the universal set that are not used for this job, are shown in dotted lines in the tool layout.

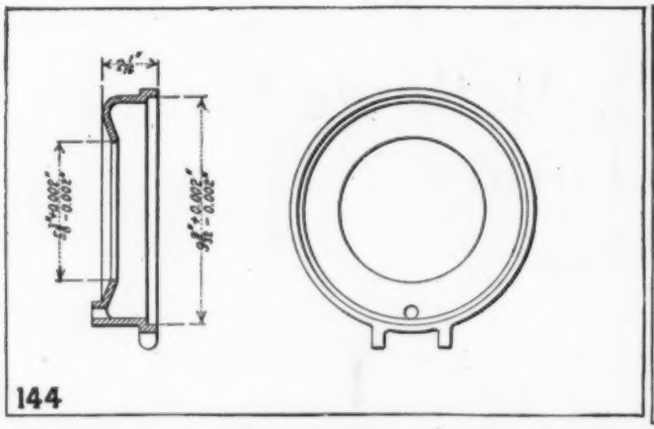
This permanent arrangement of tools keeps the set-up time very low. Since no changes are made in the mounting of the tools, the set-up time is confined to adjusting, sharpening and mounting the cutters.

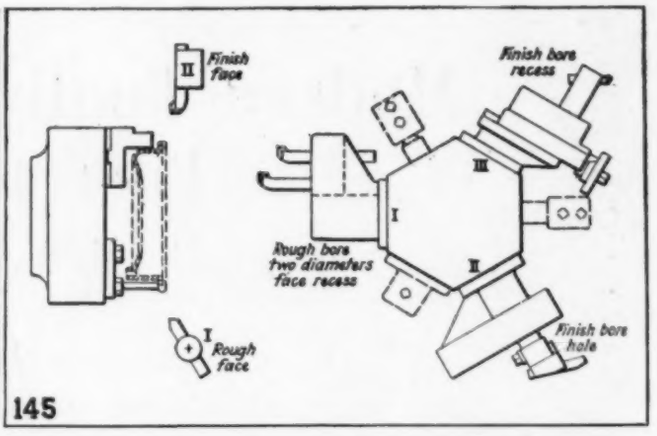
The adjustable-angle cutter holder, Fig. 147, provides micrometer adjustment for the cutter bits. This holder greatly facilitates setting the tool, particularly for finishing accurate diameters. The holder is hardened throughout and is extremely rigid, although very compact in size.

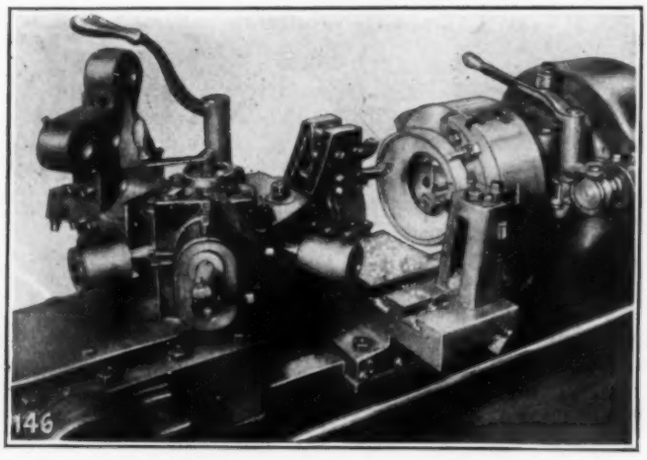
The material for the chuck wedge shown in Fig. 148 is a steel forging, S.A.E. 1020 specification. The first chucking finishes the 5⅛-in. end. The tooling layout and the machine as tooled are shown in Figs. 149 and 150. In Figs. 152 and 153 are shown the tooling layout and the machine as tooled for completing the piece in the second operation.

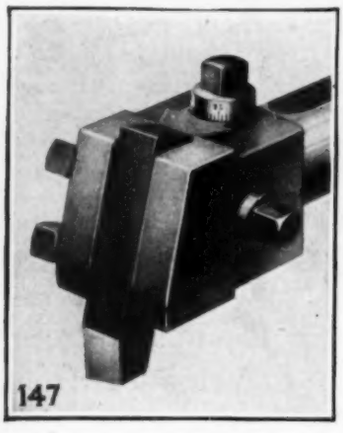
A study of the piece suggests multiple cuts from the hexagon turret, for rough turning and boring, while at

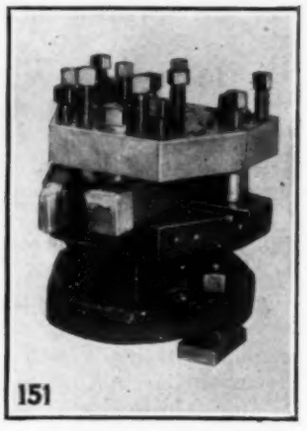
The eighth article. The ninth will appear in an early issue.

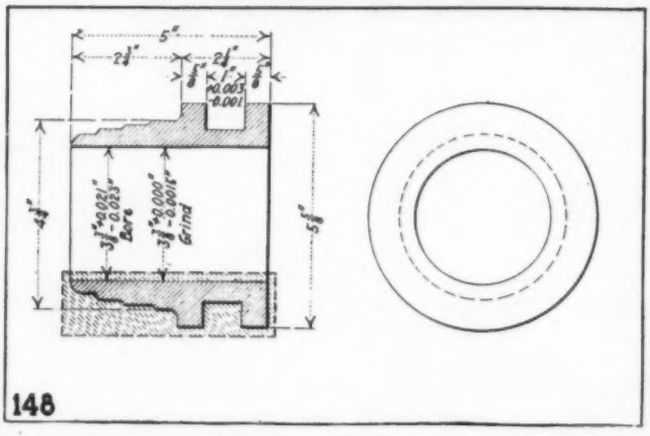


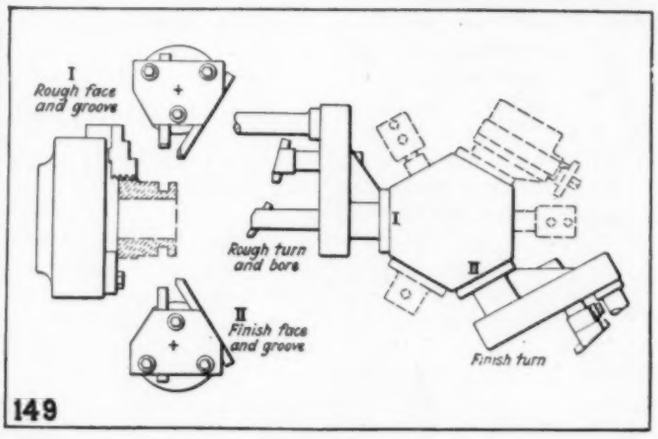


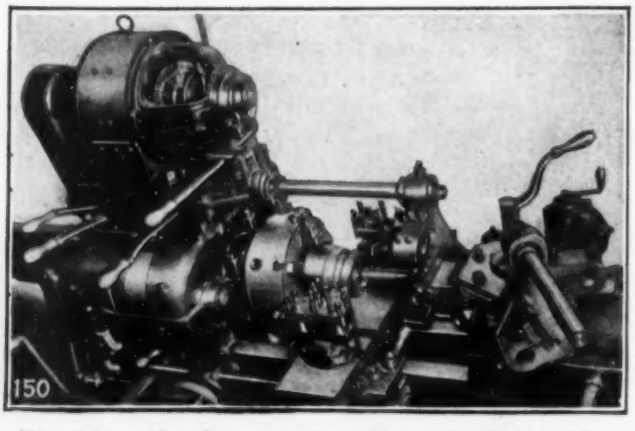












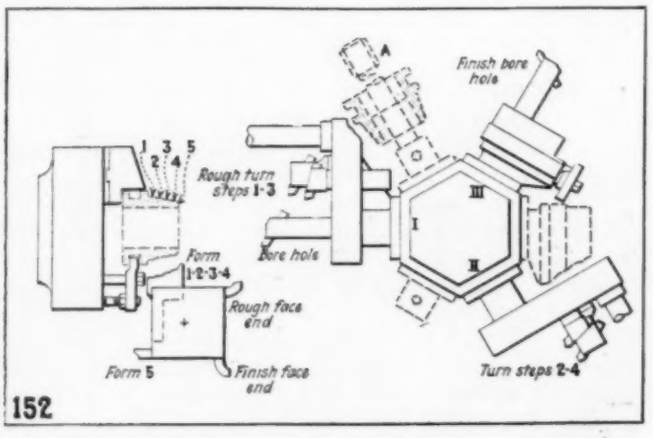
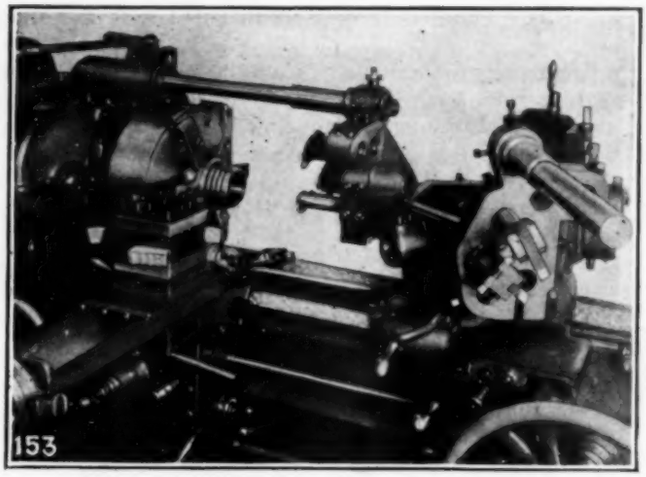


Fig. 144—*Aluminum cover.* *Fig.* 145—*Tooling layout for aluminum covers.* *Fig.* 146—*Machine tooled for aluminum covers.* *Fig.* 147—*Adjustable-angle cutter holder.* *Fig.* 148—*Chuck wedge.* *Fig.* 149—*Tooling layout for first operation on chuck wedge.* *Fig.* 150—*Machine tooled for first operation on chuck wedge.* *Fig.* 151—*Cross-slide cutter block.* *Fig.* 152—*Tooling layout for second operation on chuck wedge*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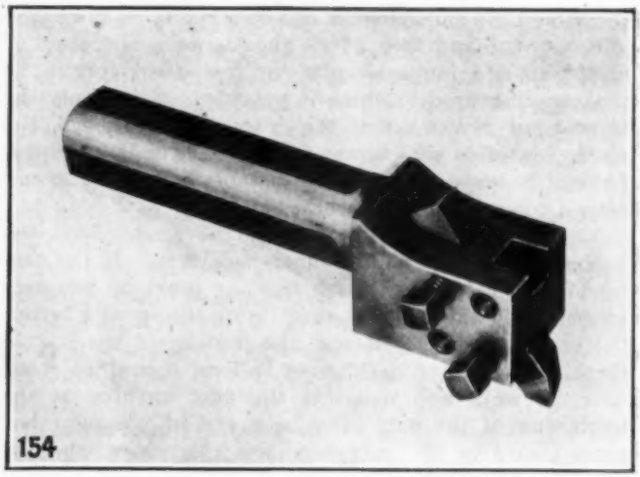
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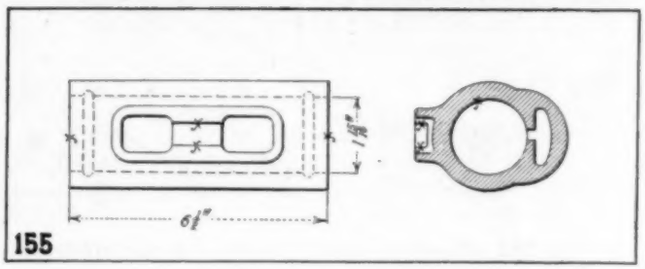

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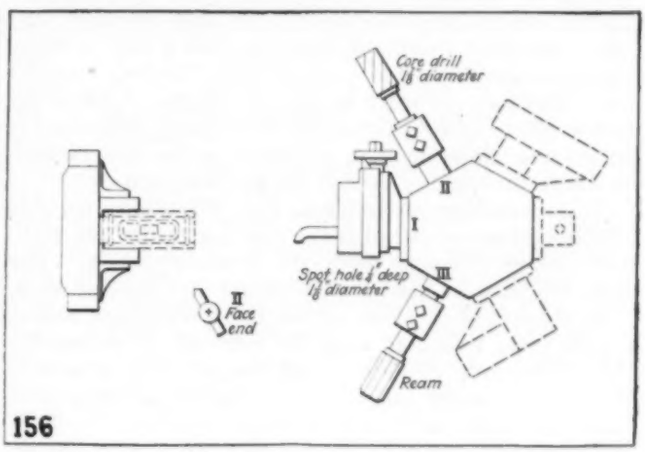

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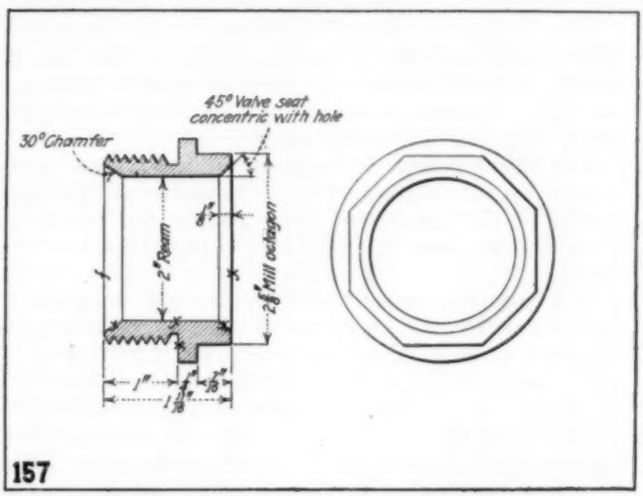

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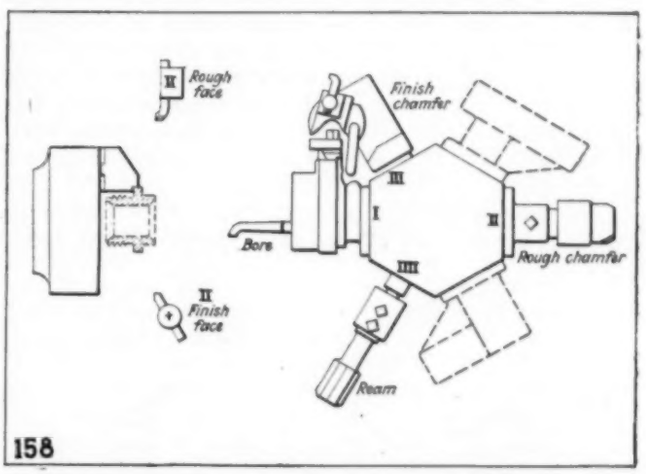

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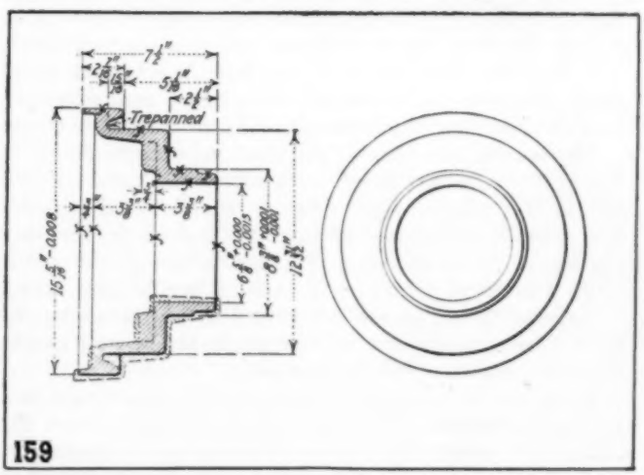

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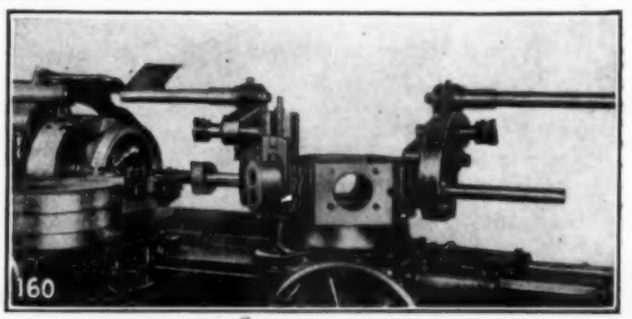
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Fig. 153—Machine tooled for second operation on chuck wedge. Fig. 154—Angle cutter-holder. Fig. 155—Cast-iron bearing box. Fig. 156—Tooling layout for bearing box. Fig. 157—Steel valve-cage. Fig. 158—Tooling layout for second operation on valve-cage. Fig. 159—Commutator shell. Fig. 160—Machine tooled for first operation on commutator shell

the same time multiple cuts can be taken from the cross-slide to form and face. This simultaneous operation of combined and multiple cuts requires great torque, so that an all-geared machine is provided. Since only the in and out movement of the cross-slide is needed, the plain cross-slide with power cross-feed is used. A chuck having standard jaws with adjustable back stops is employed for gripping the work.

The amount of tough metal to be removed on the wedge makes very rigid tooling necessary. If the center-pilot bar is to be used, the bar must be properly supported in the pilot bushing inside the spindle before the cutting begins. Hence, the portion of the bar in front of the cutter itself must be long enough to reach into the work and well into the pilot bushing at the beginning of the cut. The back end of the pilot bar must also give the necessary tool clearances when at the end of the cut.

The best practice for this type of work requires that the center-pilot bar be at least two and a half to three times the length of the finished hole. In this case the bar would have to be 13 in. long, while the travel of the turret slide is only 12 in. Hence, it is advisable to use an overhead type of pilot, as shown in the illustrations, to obtain the rigidity needed for the heavy cuts.

The cross-slide cutter block, Fig. 151, makes possible multiple facing or forming for practically any job, without tool interference with the hexagon turret. The same tool may be used for either bar or chucking work.

In the second chucking of the automatic chuck wedge, considerable material must be removed to shape the stepped contour. Hence, an all geared drive is used to give the necessary torque, and a sliding saddle type of turret is employed to provide great rigidity.

The work is gripped in soft jaws on the previously finished surface, with three clamps added to give additional holding power for forming the wide contour. If clamps are not readily adaptable to the shape of work of this type, a cast-iron bushing mounted on a plain bar in the hexagon turret is suggested to support the work when forming. This method is shown in dotted outline in the tool layout in Fig. 152 at *A*.

The four steps of the contour are rough turned in two operations from the hexagon turret. First, diam-

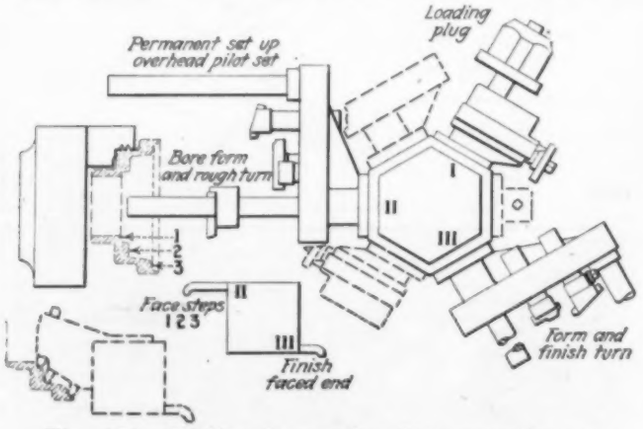


Fig. 161—Tooling layout for first operation on commutator shell

eters 1 and 3 are rough turned while the bore is semi-finished; a good example of multiple cuts. Then diameters 2 and 4 are rough turned from the second turning head. The turning cutters in this tool are simple bits held in angle cutter-holders, one of which is shown in Fig. 154. The hole is next finish bored with the slide tool.

Since the production of this wedge is about 300 per year, a wide, forged forming-cutter, held in the square turret is most economical for finishing the contour. For smaller quantities, such a cutter would not pay for itself and it would be best to use a simple cutter to form each step separately. Such a cutter can be quickly ground from a straight bit.

As in the first chucking, rigidity for the roughing cuts is obtained by an overhead-pilot bar, so that a simple,

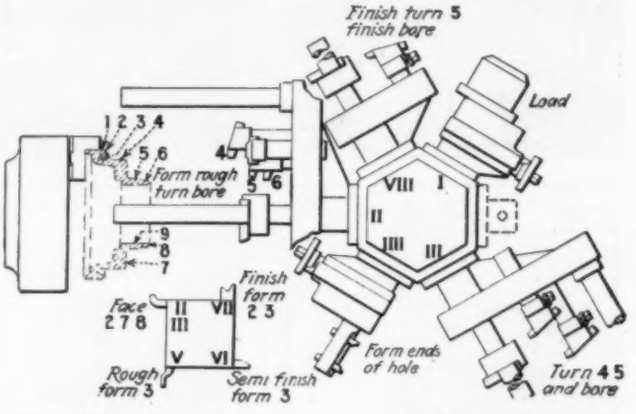


Fig. 162—Tooling layout for second operation on commutator shell

stub boring-bar can be used. The stub bar can be readily adjusted in and out from the head to suit various jobs. Because no reamer is used, the finish-boring bar is mounted in a vertical slide tool.

The offset holder is valuable for heavy-duty work where two diameters have to be finished that are very nearly of the same size. The amount the cutter bit projects from one of the holders is greatly reduced by this tool.

The cast-iron bearing box, Fig. 155, is machined in lots of twenty on a 16-in. turret lathe of the ram type. In order to finish the cored hole true, a boring cut is first taken with a single-pointed, forged cutter for a depth of $\frac{1}{4}$ in. to give the core drill a true start. The universal set of chucking tools, Fig. 156, is used again, together with a shell type core drill and reamer. The core drill is ground with its end square instead of at an angle, so that it will not follow the core. The reamer for the finishing cut is mounted in a floating toolholder.

If the hole must be very true with the turned diameters, the slide tool in station I is again used after the core drilling, for finish boring the hole to reaming size.

The second chucking of the steel valve cage shown in Fig. 140 in the previous chucking section, and in Fig. 157 in this chapter, will now be described. The taper seat must be finished concentric with the hole, the tooling layout being shown in Fig. 158. On account of the large amount of metal in the hole, a preliminary rough boring cut should be taken during the first chucking. By taking both finishing cuts at once in the second chucking, concentricity will be assured.

First, the hole is bored with a forged cutter held in a vertical-slide tool. Then the seat is roughed with a flat cutter and accurately faced with a standard, angle-rack tool. Finally the hole is finished with a reamer held in a floating toolholder. By reaming the hole last, no burr is left in the finished hole.

The rough, drop forging for the commutator shell,

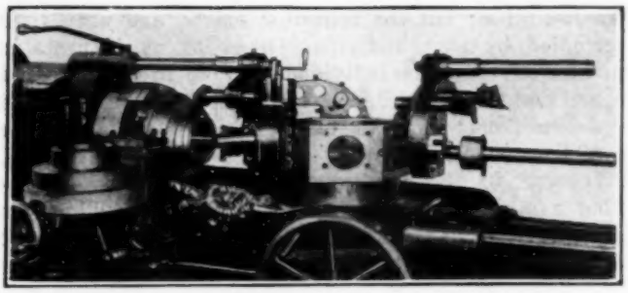


Fig. 163—Machine tooled for second operation on commutator shell

Fig. 159, is about 16-in. in diameter and weighs 116 lb. About 30 lb. of stock must be removed, so that sufficient power must be obtained to pull deep, multiple cuts from the hexagon turret, with a feed of 0.035 in. per revolution. Hence, a large, sliding-saddle type of machine, Fig. 160, is used with both overhead and center pilots to give extreme rigidity. Thus heavy cuts can be taken without loss of accuracy.

In the first chucking, the commutator shell is gripped on diameter 4 by hardened and corrugated jaws. The jaws are of the solid type, as described in a previous article, due to the considerable overhang. In the second chucking, soft, removable top-jaws can be used because of less overhang. Since the hole must be concentric with the V-groove, a rough boring cut to relieve the metal is taken in the first chucking. The finishing cuts are therefore taken in the second chucking, as will be discussed later.

This job, as described, is done in lots of 100 pieces; therefore, the inside faces 1, 2 and 3 are machined with a simple forged cutter held in the square turret. If large quantities are to be produced a special toolholder mounted in the square turret might be used, as shown in Fig. 161 in dotted lines. The three cutters mounted in this holder cut 1, 2 and 3 at once, so that the time for this operation is greatly reduced. The cost, however, of this special toolholder is so much greater than the method shown in the tool layout, that about 1,500 pieces must be produced before the saving pays for the holder itself.

Notice the loading plug for the work in station I of the turret.

In the second chucking, three outside diameters must be finish turned, the hole finish bored to close concentricity with the V, and the V-groove accurately formed.

The roughing station II, Fig. 162, turns diameters 4, 5 and 6, bores the hole 9, and also rounds the corner of diameter 4. Thus in all, five cuts are working at once, affording an example of multiple cuts. At the same time the square turret faces diameters 2, 7 and 8, thus combining cuts. The use of overhead pilots assures rigid tooling, and the addition of a center pilot for this unusual job, makes possible the maintenance of feeds of 0.035 in. per revolution of the spindle.

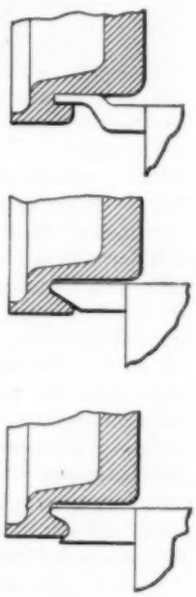


Fig. 164 Method of deep grooving

Next, a similar turning head in station III finish turns diameters 4 and 5, and the hole 9. In station IIII, a slide tool with two cutters in the bar rounds both ends of the hole. From station VIII, a final boring cut is taken in the hole 9, and the diameter 5 is turned a third time to assure the close limits of these two dimensions.

The finishing of deep grooves parallel with the center line of the machine from the solid stock, offers a rather difficult problem. If the grooves are at all narrow, it is not possible to use very rigid cutters. The method shown in Fig. 164 has been successful.

First a cutter, similar in shape to a cutting-off cutter, ground hollow on the inside and convex on the outside to conform to the outline of the work, digs into the solid metal.

Then a rough forming cutter is fed in sidewise part way and then outward, in a series of steps.

Lastly, the combined taper- and radius-forming cutter is fed into the groove to finish the contour accurately.

Seen and Heard

BY JOHN R. GODFREY

The foreman's job

A FOREMAN'S job isn't a bed of roses in all shops, or even in many shops. For it's an unusually well managed organization where the foreman isn't made some relation to the goat in many cases. The higher-ups think it's up to the foreman to put across any ruling they make, no matter if it doesn't just square with fair play. And the men think he ought to get a raise for every man jack of them, whether they've earned it or not.

The foreman is expected to do so many things that it's a wonder he does half of them as well as he does. He is supposed to devise new ways of doing work at a lower cost; to show any man or boy the best way to run any machine; to cobble up an old, decrepit machine that has long ago earned its place in the junk pile, so it will produce economically; to maintain discipline; to make every man believe the company is the finest in the world, whether it is or not; and above all to get out more and more work per dollar every month. It's *some* contract—but it often comes nearer to being filled than we have a right to expect.

Many shop managers seem to think that the foremen ought to do all the managing while they sit in the office. And then they get peeved when a foreman thinks he ought to get at least as much money as some of the piece-work operators under him. The glory of being foreman doesn't pay the butcher, and the underpaid foreman isn't a good investment in any shop.

The foreman's duties vary, of course, with the shop organization. But except in a few cases his duties are too varied to get the best results. If he is expected to teach apprentices and to keep his eye on all new men to see that they don't smash the machines, he ought not be expected to design new tools and fixtures, and estimate on contract work. When you spread a foreman's activities in too many directions, the best of 'em get pretty thin in spots.

Before you get to thinking too hard about the way the foreman seems to be falling down, it might be a good plan to jot down a list of the things he is supposed to do. You'll probably find it a larger list than you think.

The Man in the Shop and Mathematics—Discussion

By Harry Senior

IN THE opening paragraph of his letter entitled "The Man in the Shop and Mathematics" on page 8, Vol. 64, of the *American Machinist*, Harold R. Goodrich has stated a lamentable, but obvious, truth. He does not, however, lay sufficient stress upon the real reason why the mechanic instinctively evades the responsibility of doing his own figuring, or, if he figures for himself, why he insists upon having his results checked by someone "higher up."

The mechanic—I assume that Mr. Goodrich is considering the toolmaking class—uses many fine and somewhat complicated tools, with most of which he becomes so familiar through constant daily association that to apply them to the work in hand becomes a sort of "second nature." He does not have to think, consciously, about the process any more than the skilled musician has to think where to put his fingers in order to produce the sounds indicated by the score before his eyes.

Far from the least complicated but probably about the least frequently used of the tools with which the toolmaker is called upon to work, are the figures by means of which he translates theoretical dimensions into measurable distances. It is not because he has never learned to use them that he is skeptical of his own ability to do so correctly, but because he uses them so seldom that their employment involves conscious and laborious mental effort. If the same toolmaker used his vernier but once a year, would he not be justified in asking his bench neighbor to verify the reading whenever he had occasion to apply the tool?

Is the Memory at Fault?

I believe there are very few men in the toolmaking class who are without knowledge of the rules and functions of the right triangle, but I believe there are many to whom the application of them is so unusual that they are obliged consciously to recall the nomenclature and processes; and this conscious mental struggle automatically creates a doubt as to whether or not the memory itself may be at fault.

How many of us who exercise our knowledge of trigonometry but semi-occasionally, can say without hesitation or uncertainty just which side of the triangle is represented by sine, cosine or radius; by radius, tangent or secant, as the case may be? How many of us can put our fingers on the familiar drawing and say "these lines are such and such parts of this angle?"

I have asked this question many times of men and boys who, I was certain, had known at one time and who should know at the moment of asking, and the answer is almost invariably: "This line is the—ah—is——. Now let me think. Why, yes! this is—um-m-m——. I'll look it up in the book so as to be sure."

I know. I've said it myself many times. Even as I write I have open before me a copy of a book well known to shop men; written by a man who (I have no doubt) doesn't know any more about the subject than I do. And I'll bet a pint of peanuts against a brass doughnut that if anyone should ask him the question unexpectedly his answer would be very much the same.

Like Mr. Goodrich, I have no wish to make sport of the condition; but the condition exists, and until it is remedied by each individual in-so-far as it pertains to himself, and the individual is able to use his lead pencil and his knowledge of trigonometry with the same freedom from conscious effort, and the same sublime confidence in the accuracy of his findings (warranted, of course, by the results) that he displays when slipping a micrometer over a round plug and telling you how big it is to the "steen thousandth" of an inch, he should stick to the book.

An Inspection Pitfall—Discussion

By Charles Doescher

To my mind one of the most interesting pages in the *American Machinist* is the one on "Practical Shop Problems." The questions of a practical nature are always interesting, as are the answers thereto.

The question asked and answered under the title, "An Inspection Pitfall," Vol. 64, page 32, was of special interest to me. In fact, it has interested me to the extent that I am going to add just a little more "dope" on inspection that may prove to be of interest and service to the readers of the *American Machinist*.

An important point to be observed is that when an inspector finds defective work, he should, after stopping the machine doing the defective work, immediately notify the foreman of the room and should then trace the job back in order to find *all* of the defective pieces that have been made since he last checked up the work of this particular machine. If the work is spoiled so that it can not be repaired or salvaged in any way, he should scrap it immediately. If spoiled work is allowed to stand around the room a minute longer than is necessary, the first thing you know is that some one will get hold of it and put it into production again.

Similarly defective work that can be saved by putting in an extra operation should also be removed from the room and should be put in a safe place until it can be repaired.

If the above is lived up to, there really ought to be very little defective work coming through, provided the inspector is on to the job and has the good will of the foremen and the operators.

In this connection, it may not be amiss to say that the inspector who goes about his work with a chip on his shoulder, trying to get something on the other fellow so that he can tell the man higher up, will never get anywhere. It is the inspector who likes his job and who goes about it with a spirit of helpfulness toward both the foremen and the operators that gets results. Any inspector who keeps his work going right, day after day, is performing a real service not only to the company, but also to the foremen and to the operators in the particular room where he is employed.

One of the last things that an inspector should do is to go to the man higher up to complain about not getting co-operation from such and such a foreman. A foreman, who has any common sense at all, knows that a live inspector who keeps his work going right is saving him (the foreman) a whole lot of trouble, to say nothing of keeping him from being called on the mat. It can, therefore, be seen that the mutual interests of both the foreman and the inspector are best served by willing co-operation on the part of both and by a mutual understanding and respect.

Handling Locomotive Repairs to Meet a Scheduling System

By Frank W. Curtis
Western Editor, *American Machinist*

Modern machinery used to meet a schedule of repairs—Grinding air-compressor cylinders — Milling connecting rods — Home-made machines — Portable tools

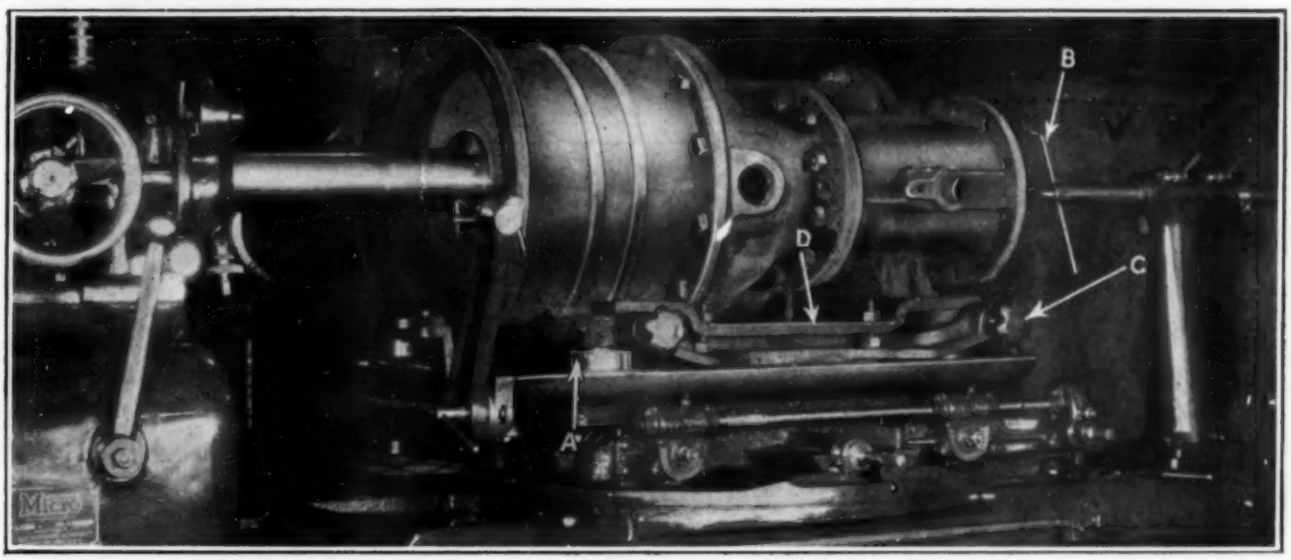


Fig. 1—Machine used for grinding air-pump cylinders

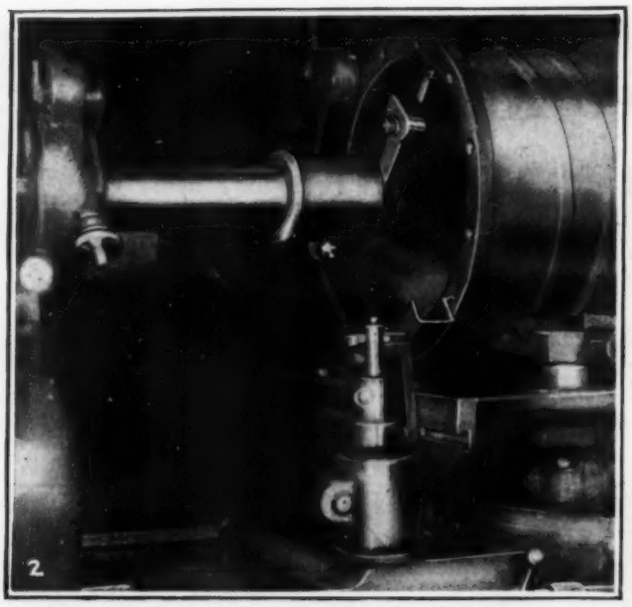
IF A SHOP adopts a scheduling system for repairing locomotives, and the work is turned out on schedule, it is natural to expect that the equipment is modern and in good condition. Old, run-down machinery cannot be depended upon to turn out a definite amount of work in a given time.

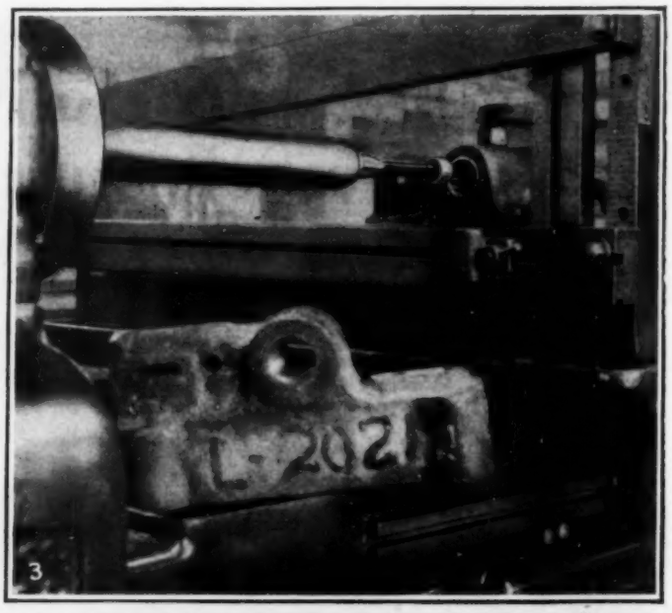
The Silvis shops of the Chicago, Rock Island & Pacific Ry., although twenty-three years old, are being constantly improved in operating efficiency by both the application of new machinery and the adoption of improved methods. The shop turns out between twenty-five and thirty major repair jobs each month that are handled according to a schedule that was described on page 341, vol. 64 of the *American Machinist*. If necessary, the number of repairs could be increased to forty-five engines per month.

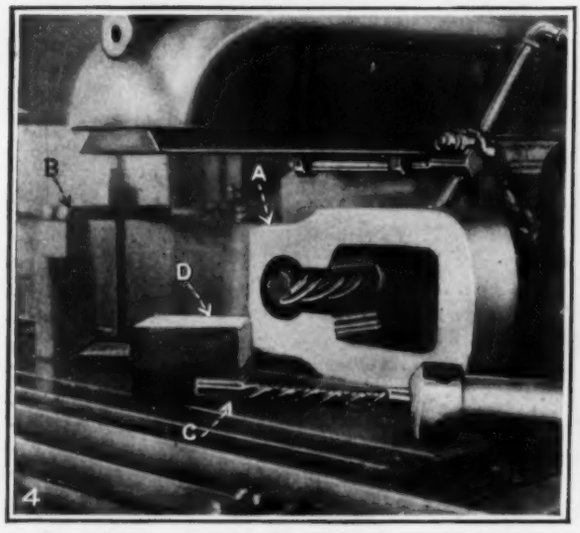
Among the latest equipment to be seen in the shop is a Micro, FG, internal grinding machine, shown in Fig. 1. The machine is used for reconditioning the cylinders of air pumps. These cylinders are ground while assembled to the center casting, a method that eliminates misalignment, out-of-roundness, tapered and rough holes. The unit is mounted on a swiveling fixture that has circular, vertical and cross feeds. Four leveling jacks *A* are located between the fixture and the work. These jacks have a rocking motion to compensate for irregularities in the castings. The cylinders are laid out with center-punch marks to facilitate temporary leveling by means of the jacks. The needle pointer *B* is used in the final positioning. Side shifting is accomplished by means of the screws *C*. The clamps *D* bear against the flanges, as shown. The illustration shows the abrasive wheel in position in one of the cylinders.

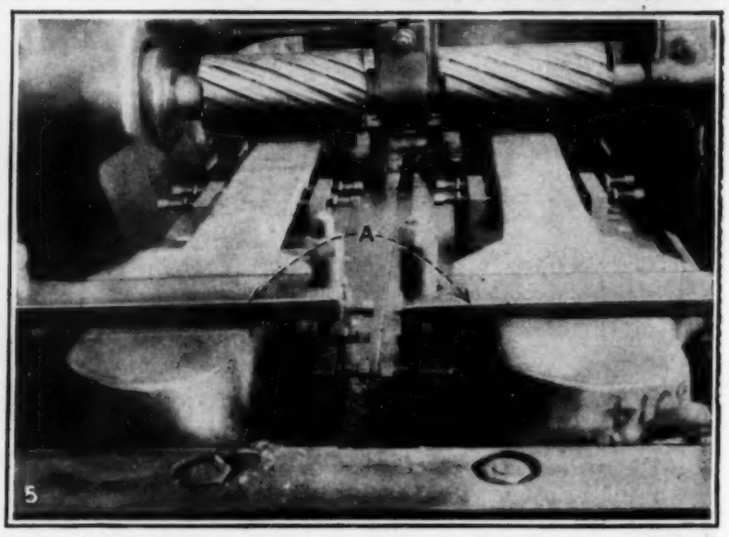
In addition to grinding, the machine is used for beveling the front and rear ends of the cylinder by applying the tool and tool holder shown in position in Fig. 2. The holder is fastened on the spindle in place of the wheel. The reamer shown standing on the table of the machine, is mounted on the spindle for reaming the stuffing box hole. By grinding the cylinders in one setting, which insures proper alignment, it is possible to fit the pistons to close limits, 0.001 in. to each inch of cylinder diameter, with the assurance that binding will not occur at any position of the stroke. Wear will be reduced to a minimum. The average time required for the operation is 4 hr. floor to floor time. The machine is used also for grinding the large bore of the locomotive main rod, necessitating an angle fixture for the clamping of the work.

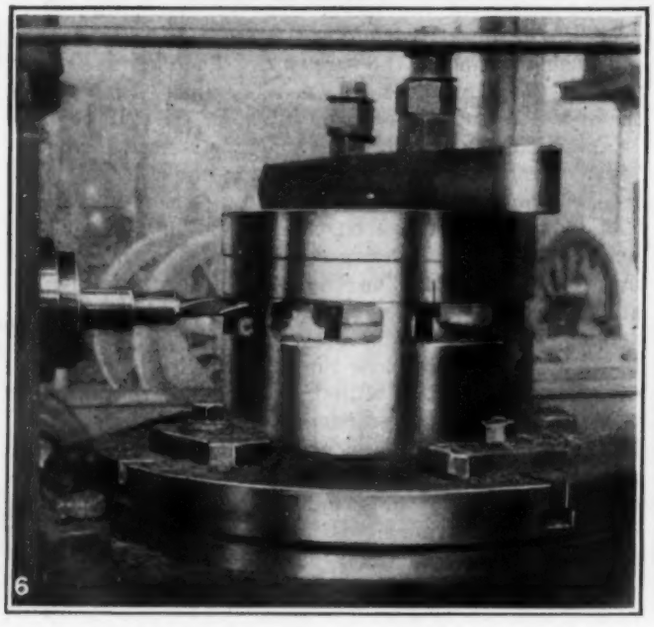
For the internal grinding of smaller work, the Heald machine shown in Fig. 3 is used. The work shown on the machine is a valve-rod crosshead in which a case-hardened bushing is ground to 1.75 in. in diameter. The length of the bushing is 4½ in., and approximately











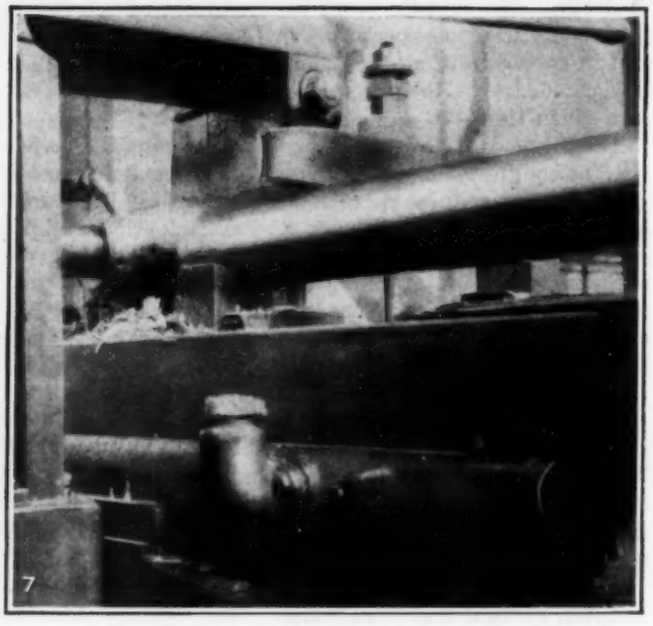
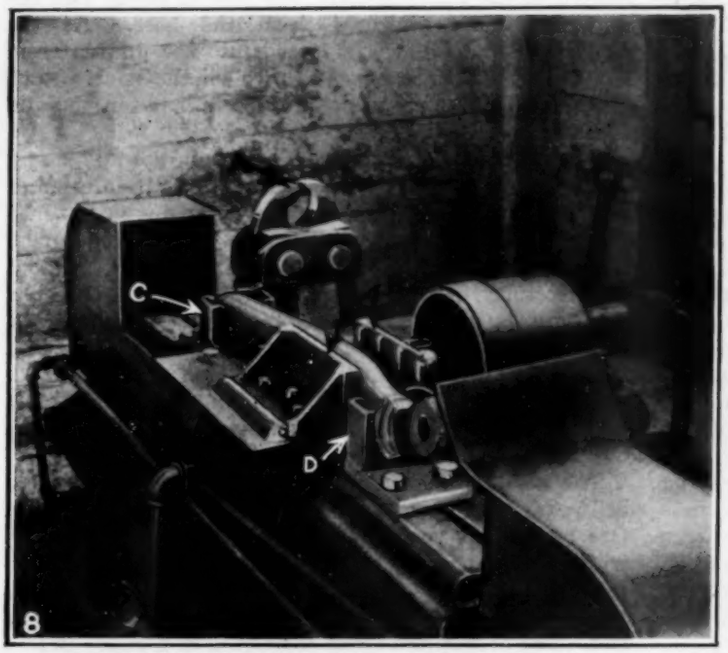
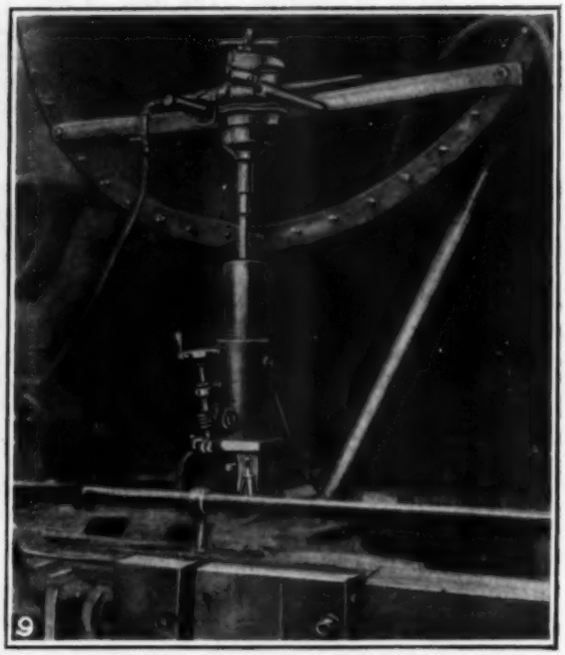
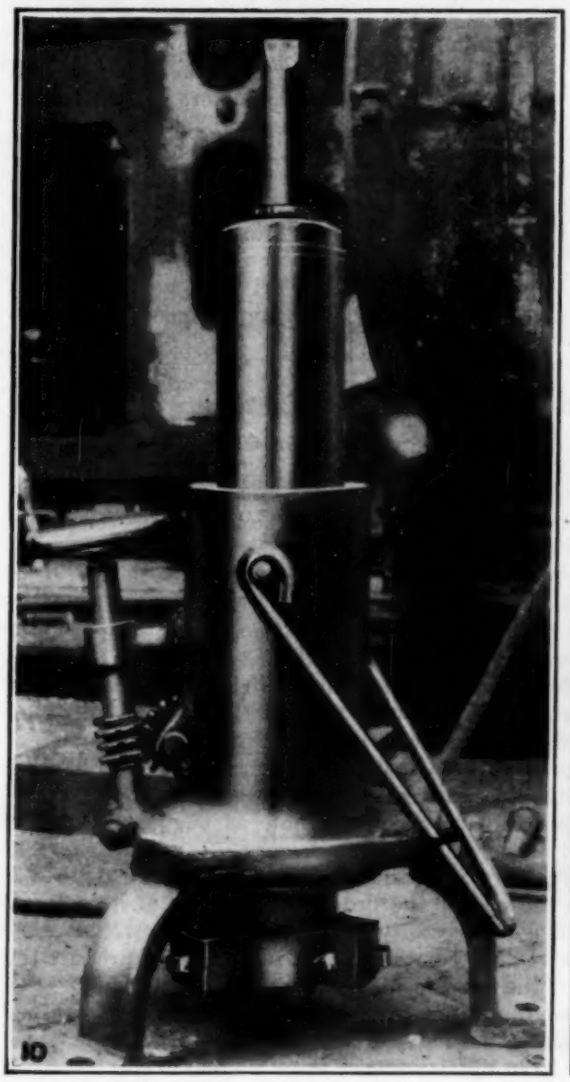
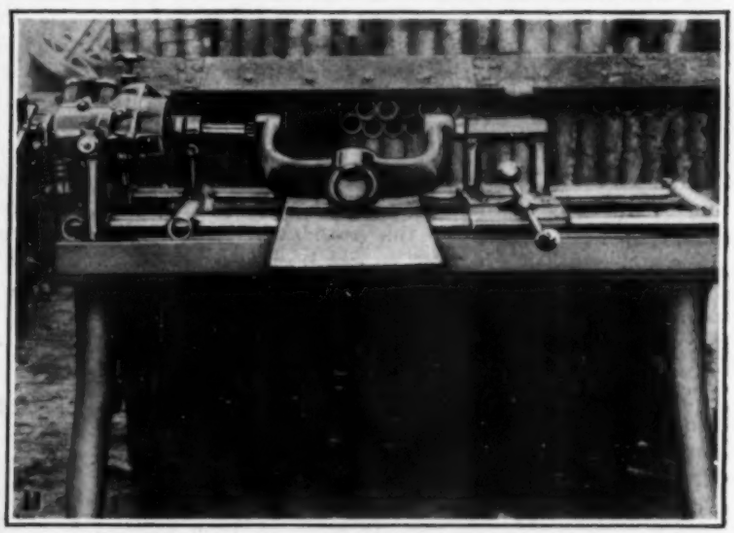


Fig. 2—Close-up view of machine showing boring tool. Fig. 3—Grinding bushing in valve-rod crossheads. Fig. 4—Cutting out opening in main rod. Fig. 5—Milling side of main rod. Fig. 6—Machining ports of cylinder bushing. Fig. 7—Cutting elongated holes in piston rods









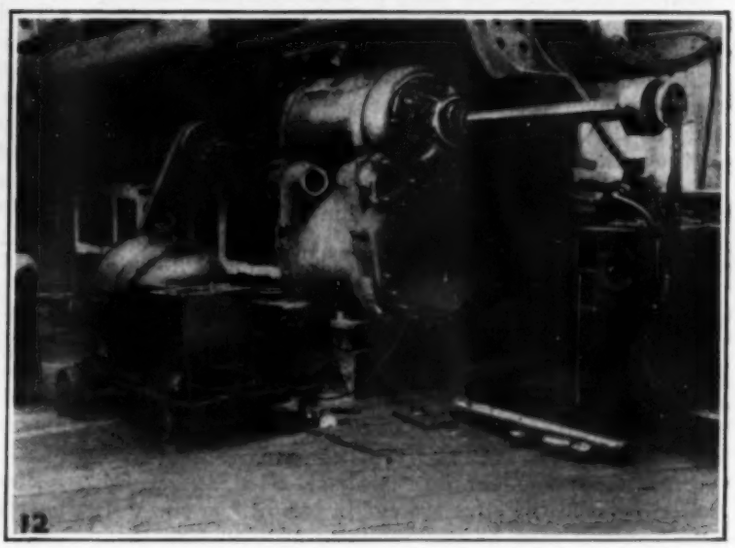


Fig. 8—Air-hose stripping machine. Fig. 9—Machine for boring king-pin holes. Fig. 10—Close-up view of boring unit. Fig. 11—Reaming bell-yoke casting. Fig. 12—Portable motor used in erecting pits

$\frac{1}{64}$ in. of metal is removed. The floor to floor time is 14 min. The machine is used for the grinding of combination levers, valve rods, link rods, link blocks, gear connecting-rods and link-arm and reverse-lever bushings. The angle-plate fixture together with V-blocks is used for holding cylindrical work such as bushings. All the grinding is done dry.

The method of machining the large opening in a main rod is shown in Fig. 4. The rod, prior to this operation, is drilled and bored out to 4 in. in diameter at *A*. It is clamped on the table of the machine, a Cincinnati milling machine, by three strap clamps as shown at *B*. The 1-in. helical cutter, *C*, supported by the overarm of the machine, is started in the 4-in. hole and fed around the contour of the opening at 228 r.p.m. and $\frac{3}{4}$-in. feed. This operation cuts out the block shown at *D*. The $2\frac{1}{2}$-in. helical cutter shown in the spindle of the machine then is used for finishing the hole. This cutter operates at 60 r.p.m. and $4\frac{1}{4}$-in. feed, removing from $\frac{1}{32}$ to $\frac{1}{16}$ in. of metal. The rod is 4 in. in thickness and the large opening is $6x7\frac{1}{2}$ in. The section between the 4-in. hole and the opening is 3 in. in width and $2\frac{1}{2}$ in. in length. The operation is completed in an average floor to floor time of 2 hr. Soda water is used as a coolant and cutting compound.

The slab milling of main rods is handled in pairs as shown in Fig. 5, on the Niles-Bement-Pond machine. The rods are held at the head ends by the clamps *A*. When the cutter is set for machining the heads, the clamps are set over the central portion or body of the rods. Two inserted-tooth spiral milling cutters 10 in. in diameter and 18 in. in length are used. For the milling of the body of the rod the cutters run at 19 r.p.m. and 6-in. feed, while for the head ends they run at 15 r.p.m. and 3-in. feed. The depth of the cut varies from $\frac{1}{16}$ to $\frac{1}{8}$ in. Both sides of the rods are finish milled in 7 hr., floor to floor time. After this operation the rods are milled on the edges and ends after which the channels are machined.

The ports of the cylinder bushing are milled on the Cincinnati machine shown in Fig. 6. There are seven ports to each bushing that are finished to $4\frac{1}{2}$ in. in length and $1\frac{3}{8}$ in. in width. An $\frac{11}{16}$-in. end mill is used. The work, clamped on a circular table, is fed into the cutter, after which the table is revolved, then lowered and raised until the hole of desired size is obtained. The operation is completed in 35 minutes.

Another operation handled on the same machine is the cutting of the slots for cross-head keys in piston rods, as shown in Fig. 7. The rod is located in V-blocks on the machine table and held by two clamps. Two $\frac{1}{2}$-in. holes are drilled through the tapered section of the rod, after which the web between them is milled out by a $\frac{11}{16}$-in. helical mill. The width of the finished hole is $\frac{7}{8}$ in. The time required for the operation is 35 min. A rod having a hole $1\frac{1}{4}x4\frac{3}{4}$ in. also is handled on the machine in the same manner.

To overcome hand work and operations that cannot be handled on standard machinery, there have been constructed several home-made machines of which some are illustrated. In Fig. 8 is shown an air-hose stripping machine used for stripping nipples and couplings from worn hose. The entire unit is air-operated. First, the bolts that hold the clips are cut in two by the shear *A*. The operator then loosens the clips by pounding them with a hammer. The hose assembly then is placed in the vise *B* while the ends are located in the jaws *C* and *D*. By means of the air cylinder *E* and two air cylinders located in the machine-body, the vise in closed and the couplings are withdrawn from the hose. As the couplings let go they are forced into the guards from which they fall into boxes located on the floor. With this machine, one man is able to strip between 450 and 500 units per day.

A home-made tool for boring king-pin holes is shown in Fig. 9. The machine is operated by the air motor that is supported by a strap. To the motor is fastened a driving bar of square section, that drives the boring spindle, allowing it to be fed into the work without the necessity of changing the position of the motor. The unit is strapped to the engine by three clamps. Fig. 10 shows a close-up view of the device. The feed is through worm, spur gear and rack, and is hand-operated. The boring head is arranged for three tool bits. The bale is used in handling the unit with the overhead crane.

The machine shown in Fig. 11 is used for reaming bell yokes. An air motor is used for driving the reamer. One end of the yoke is located against the bull center, which is advanced by turning the ball crank, thus causing the other end of the yoke to advance over the reamer. The operation is repeated to ream the second end. The operation is now completed in 2 min. Before the installation of the machine the operation required from 50 to 55 min., due to the awkward shape of the work.

For driving portable machinery such as is used in the erection pits, a portable electric motor, mounted on a small truck, is used. The unit may be seen in Fig. 12 set up for operating a cylinder boring. tool. All controls are mounted on the truck, making the unit self-contained. A plug is connected in the nearest switch for current. The unit may be transported by crane by using the hook located on the top of the motor. The motor offers sufficient power to drive the portable equipment uniformly, thereby insuring a smooth finish.

Unethical Use of Manufacturers' Drawings —Discussion

By F. P. Terry

In the opinion of the writer who was interested in the editorial on page 488, Vol. 63 of the *American Machinist*, where machine tools are concerned, the giving out of the fullest details of parts by a manufacturer, particularly where they are sent long distances, is a valuable asset both to the seller and to the buyer.

Quite recently we sent out inquiries for a special type of machine, asking at the same time for detail drawings of all working and wearing parts. This seemed a necessary procedure to insure no delays from breakdowns. One firm that carried out our wishes to the fullest extent got the order. No doubt, as suggested by the editor, abuse of the privilege does occur and firms use the drawings to manufacture parts themselves. But where the use of the drawings is really unethical and not simply a necessity, the manufacturers would probably have adopted other means in order to reproduce the parts if the drawings were refused to them.

Since the detail drawings of the various machines have saved me many hours of work in avoiding stoppages from breakdowns, I have a great respect for the manufacturer who supplies them and am always ready to return the compliment. It also gives me greater confidence in his machines.

Attitude and Profits

By W. Edward

ONE of the strongest factors in the conduct of an inspection department is the attitude that can be instilled in the men of the department itself, but no less is the importance of building up the same attitude in the production forces. Depending on this, is the direct measure of the usefulness of inspection to economical production.

It is a comparatively simple matter for one with acquaintance of the subject to tell, after a casual glance through a chain of production departments, which way this attitude trends.

Assume that a part is encountered on which trouble has come up. There is not enough metal left to perform a finishing operation. Several hundred parts are in question, representing a seriously large investment in materials in process. The limits shown on the drawing cannot be held to. This is about what happens in some plants.

A Good Example

The operator, on the machine, reports to his foreman and the latter, looking over the work, finds that a previous operation, not under his jurisdiction, has been done wrong. He instructs the operator to return the parts in question. It is not up to him. He did not make the error. Let the other fellow worry. He is not going to take a chance on being shown up by the inspector for trying to get anything by. Get them out before his department inspector can see them. No, don't say a word to him, it would not do any good and would probably start a row, with him being accused of trying to put something over. No chance of the inspector letting himself into any hot water, as he did once before. That once was enough and then some. Shoot them back, perhaps the other fellows can worry out of the trouble.

Said the foreman to the inspector, "Well, I beat you to it, darn your hide. I sent a thousand parts, No 906, back defective on operation No. 4. What's the matter with your inspector hound back there? He has gone to sleep again I guess. He'll get the can, when the old man hears of the mess."

Said the inspector to the foreman, "Darn good thing you sent them back. I knew they were wrong, but I was hanging low to nail you for the last time you got me in dutch."

Said the cost department, "The thousand-dollar jump in scrap was due to making 1,000 defective parts number 906 on the fourth operation."

Or again, the following is what occurs in a different sort of organization:

The operator on the machine reports to his foreman, who, at once, gets hold of his department inspector. Together, they go over the work and study the drawing. It occurs to the foreman that the particular dimension in question cannot be of great importance. The inspector, even though be believes in holding to the set limits, sees nothing to be gained for his company in making scrap if it can be avoided and promises to see what can be done.

He sees the inspector, through whose hands the work slipped, so he would know, first hand, what had happened. Together, they get out the drawings of the assembly into which the part is to go. The search proves the foreman's contention that the limits may, after all, be one of those cases where a draftsman has shown them as a matter of form rather than necessity.

They find, further, that interchangeability is not affected. They finally lay the facts before their chief, the one who slipped in his check, so stating, and explaining how it had happened due to a shift in a toolholder. He suggests that the holder can be altered slightly to forestall recurrance.

The other inspector shows that the part can be run as an emergency.

The chief inspector sees the engineers and checks the statement of his men. He gives his approval so far as inspection is concerned.

The engineers send altered drawings to the shop. The department foreman puts the parts through his machines. The engineers go a step further and, after making a further investigation, not only alter the toolholder, but are able to eliminate the operation in the department where the work had been caught.

Said the foreman to the inspector, "Thanks Bill, that helped us out of a hole."

Said the inspector to the foreman, "Well John, I guess that, together, we get the work through in good shape."

Said the cost department, "Five per cent is off the direct labor, on part 906, account of an abandoned operation."

Go through the shop sometime and check up on the attitude. Then go to the cost books, the order lists, the rating of the company and the statement of profit and loss and see the parallel result.

Oil and Repairs—Discussion

By D. C. Wright

THE writer was interested in the comments of L. L. Thwing, which appeared on page 803, Vol. 63, of the *American Machinist*, in regard to an article on the above subject published some time previous.

While the present national safety code on power transmission was in the process of formulation, the committee, composed of representatives of various interests, including labor, manufacturers, underwriting bodies and technical societies, had a rather strenuous time discussing the subject. Of course, their interest was mainly from the standpoint of the possible creation of industrial hazards, but the arguments developed apply equally well to the matter of service.

The arguments were so generally advanced in favor of the delegation of oiling to separate groups of men that it is interesting to note them in that they were presented from outside sources. When he speaks of the advantage of mental relaxation to be derived by the machine operator from occasional breaks in the routine of his regular duties, Mr. Thwing may be correct. As a matter of practical shop application, however, the method advanced is likely to prove unreliable under a great many conditions.

Let us assume first that a shop is operating on a standardized routine, high-speed production basis where the work of the operator is largely repetition. Under such conditions some form of piecework is usually used as a basis for wages. This being the case, it would be interesting to see what means would be adopted to induce the operator to waste (I use his expression) his

time in service operations not directly connected with his actual earning labor.

In three comparatively recent cases in order to stabilize the costs, a very liberal piecework price was placed on some old and familiar operations and inside of fifteen minutes from the time that the price was announced, the operators were searching out the foreman to ascertain what provision was to be made with regard to the lubrication of their machines. It was not that there was the slightest criticism of the price nor was there any objection made to operating under the new plan even in a shop which was adopting it for the first time after a long period of payment by the day. Rather, the operators in becoming pieceworkers resented any intrusion upon their earning time and sought to protect themselves.

Two Important Objections

It is possible, in such a case, to include a periodic interval for machine adjustments in the payment rate, but this plan has two major objections; first, the uncertainty lest a high-pressure pieceworker will yield to the temptation that confronts him to divert a portion of his allotment of oiling time to the strengthening of his day's output, perhaps if only to fortify his wages against the inevitable losses which are bound to occur occasionally through unexpected hold-ups from other causes and in the end this is bound to work to the disadvantage of the owner, through the depreciation of the equipment or through frequent repairs; second, there is the basic law of production economics which demands that the program should be so arranged as to provide as little idle "man-time" possible, idle in the sense of non-productive work.

In the case of the shop operating on a greater variety of work there are again two conditions to be taken into consideration. In the case of the larger tools such as boring mills, radial drills, planers and the like, and even in the case of certain smaller machines, the task of servicing the machine and oiling it may be very safely left to the operator since he usually is in regular charge of that particular machine and assumes a degree of proprietorship over it. However, suppose that sickness, transfer or normal labor turnover makes it necessary for a new man to be placed temporarily in charge of the machine.

Then, too, there are always present in a shop handling a variety of work, certain machine tools which, for want of a better name, might be called convenience tools. These may consist of a lathe, one or two utility drill presses, a cut-off machine, tool grinders, in fact nearly anything, depending on the circumstances. Such tools perform no routine task and have no regular operator assigned to them. Instead a mechanic may preempt one of them to work up some phase of a job which he has in hand, or, in the event of some small run of work, a handy man or even a laborer may be assigned by the foreman to run one of them.

In other words, there inevitably exist enough irregularities in the manning of shop equipment that it is usually a practical impossibility to secure reliable results from machine lubrication by the operators and it is almost essential to have some outside department assume responsibility for it. Whether this department consists of a single man who merely looks after the equipment in that particular department in addition to other possible duties, or whether a well-equipped central maintenance department looks after the equipment for a whole plant is not essential. The point is that somewhere there should be a definite person who has as his definite responsibility the care and upkeep.

In any well-organized shop provision is made for having general lubrication and service work attended to during the time when the shop is not in operation. Of course, there are times when particular equipment is temporarily out of production through lack of material, absent operators or breakdown, and a good foreman or shop executive is quick to take advantage of such an opportunity in case special attention is required.

However, whether it be during idle shop time or while regular operations are being carried out, the cheapest, most reliable and most satisfactory plan for taking care of such work is to have an independent maintenance man or department, familiar with all the routine equipment requirements and equipped with the particular tools and material which experience dictates to be most needed in an emergency.

It has been found by at least four of the largest corporations in the country, whom the writer has in mind at the present moment, that not only is the job attended to more promptly under such conditions but in a much more workmanlike manner than is the case where an operator has to tackle an unfamiliar task, usually without proper equipment, unless the man be a deliberate time-killer with the single thought of getting the thing "fixed up" some way as quickly as possible.

Diction in Catalogs

By B. J. Stern

Catalogs have always been one of my favorite forms of reading matter. No avid reader hails a new work by his favorite author with more delight than I do the appearance of a profusely illustrated, well bound circular from any one of the advertisers in the *American Machinist*. Often, however, this joy is shortlived, for as my eye runs down the columns of reading matter, it lights on such masterpieces of composition as this:

"All commercial babbits consist essentially of either tin or lead as a base, with the addition of some hardening and strengthening agent. The pure metals being too soft for practical use. Antimony ..... "

Or this: "We know, a trial will convince you."

Now, I am no pedant, and I hold no brief for the rhetorician who can spot obscure faults that are hidden from the eyes of us ordinary mortals. The examples I quote, however, are such glaring errors in English composition that one wonders how they can possibly have passed the blue pencil of the proof reader or how any one possessing the rudiments of an ordinary education could have written them. From the evidence it would seem that a catalog compiler lavishes all his care on the illustrating, the layout, the binding, and the general mechanical get-up of his pamphlet, giving but a passing thought to the grammatical construction of the descriptive matter.

The cataloger, however, is not the sole offender. It seems that the inability to write good English is about the weakest point in the average mechanical man's mental equipment, as anyone who has read engineers' reports can testify.

This outburst will probably have little reforming influence, but at least I have put myself on record against otherwise good catalogs that are spoiled by poor English.

The Design of Gear Tooth Forms

By Earle Buckingham

Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Basic racks to generate spline shafts — The theory of the involute curve and its chief characteristics when used as a gear tooth profile form

THE problems of determining the forms of hobs to produce spline shafts, ratchets, sprocket wheels, etc., are essentially gear problems. As an example, we will determine the form of the basic rack to produce the usual straight-sided spline shaft shown in Fig. 17.

The first step is to establish the pitch line which will be employed. In this example, we will take it as the outside diameter of the spline shaft.

The next step is to establish the line of action. This is necessary in order to make sure that with the established pitch line, complete conjugate action exists. If it should be possible to draw tangent circles from the center of the spline shaft to this line of action, and if these tangent circles should lie inside of the profile of the spline or other form, complete generation could not take place. (See Fig. 9 in the second article.) If this condition should exist, it would be necessary to establish a different pitch line which would avoid this condition. The method of determining the line of action is illustreted in Fig. 3.

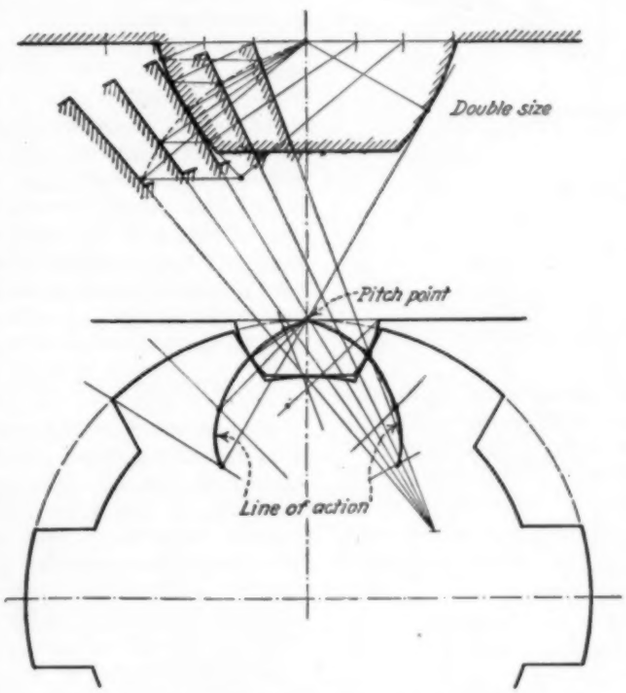


Fig. 17—Development of the basic rack for a spline shaft

The profile of the basic rack is next established. This is accomplished by the same method as was illustrated in Fig. 4 of the first article. The form of the basic rack for the spline shaft has been developed in Fig. 17. The line of action is first established and from it the rack form. This construction is laid out to double size at the top of the illustration.

The form thus determined is used as the shape of the hob tooth which will be employed to produce the desired form. Theoretically a correction in this form is required because of the side cutting action of the hob in operation. In the majority of cases, however, the error introduced by the side cutting action of the hob is less than the probable error in actually producing the form on the hob, so that this further refinement is seldom required.

The application of cycloid curves to gear tooth forms is rather limited when compared with the use of the involute curve. At the present time, this curve is almost exclusively used for gear tooth profiles. It meets all the requirements for a gear tooth profile and, in addition, has so many other valuable properties that it stands in a class by itself. These properties free it from many of the restrictions of other gear tooth shapes. In order to appreciate its many valuable features it is best to study it by itself, rather than as one of a group of gear tooth forms.

The involute is the curve that is described by the end of a line which is unwound from the circumference of a circle, as illustrated in Fig. 18. The circle from which the line is unwound is commonly known as the base circle. The equation of the involute and its derivation is as follows:

Where a = radius of base circle
b = length of generating line
r = length of radius vector
θ = vectorial angle
α = angle between radius vector and radial line of base circle to point of tangency of the generating line with the base circle.

It is most convenient to use the circular measure of some of the angles when dealing with the involute curve. The circular measure of an angle is a radian, which is the angle subtended by an arc whose length is equal to the radius. The circular measure of a complete circle, or 360 degrees, is, therefore, 2π radians.

The fourth article. The fifth will appear in an early issue.

In all of the following equations where the symbol of an angle is used without any expressed trigometric function, the angle is expressed in radians.

In Fig. 18, the length of the generating line is equal to the length of the arc which subtends the two angles θ and α, because this line has been unwound from that portion of the circumference of the base circle. Thus we have

$$b = a(\theta + \alpha)$$

But b is also the leg of a right triangle, whence

$$b = a \tan \alpha$$

Combining these two equations

$$a(\theta + \alpha) = a \tan \alpha$$

$$\theta + \alpha = \tan \alpha$$

$$\theta = \tan \alpha - \alpha \qquad (12)$$

From the same right triangle we have

$$r = \frac{a}{\cos \alpha} \qquad (13)$$

These last two equations are the simplest form in which the equations of the involute of a circle can be given. They can be combined, and the third variable α eliminated as follows: Refering to Fig. 18,

$$\tan \alpha = \frac{b}{a}$$

$$b = \sqrt{r^2 - a^2}$$

whence

$$\tan \alpha = \frac{\sqrt{r^2 - a^2}}{a}$$

$$= \sqrt{\left(\frac{r}{a}\right)^2 - 1}$$

or $\alpha =$

$$\tan^{-1} \sqrt{\left(\frac{r}{a}\right)^2 - 1}$$

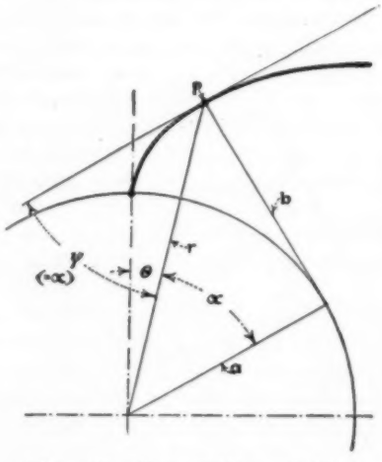


Fig. 18—Generation of the involute curve

Substituting these values in equation (12), we have

$$\theta = \sqrt{\left(\frac{r}{a}\right)^2 - 1} - \tan^{-1} \sqrt{\left(\frac{r}{a}\right)^2 - 1} \qquad (14)$$

Equation (14) is the polar equation of the involute curve. We know that the equation of the tangent to a curve measured from the radius vector is

$$\tan \psi = r \frac{d\theta}{dr}$$

$$\frac{d\theta}{dr} = \frac{\frac{r}{a^2}}{\sqrt{\left(\frac{r}{a}\right)^2 - 1}} - \frac{\frac{r}{a^2}}{\frac{r^2}{a^2}\sqrt{\left(\frac{r}{a}\right)^2 - 1}}$$

$$= \left(\frac{r}{a^2}\right) \frac{\left(\frac{r}{a}\right)^2 - 1}{\frac{r^2}{a^2}\sqrt{\left(\frac{r}{a}\right)^2 - 1}} = \frac{\sqrt{\left(\frac{r}{a}\right)^2 - 1}}{r}$$

$$r \frac{d\theta}{dr} = \tan \psi = \sqrt{\left(\frac{r}{a}\right)^2 - 1}$$

$$= \tan \alpha \qquad (15)$$

hence $\psi = \alpha$

The tangent to the involute is, therefore, perpendicular to the generating line, as shown in Fig. 18, or conversely, *the generating line is the normal to the involute curve.*

The radius of curvature at any point is equal to the length of the generating line from that point to its point of tangency to the base circle. In other words, the radius of curvature at any point is equal to b, or $\sqrt{r^2 - a^2}$.

A simple conception of the involute curve is that of a uniform-rise cam, where the rise per revolution along a line tangent to a base circle of radius a is equal to the circumference of the circle, or $2\pi a$. This is shown in Fig. 19. If this cam is revolving at a uniform rate of speed in the direction indicated by the arrow, the cam roll will rise at a uniform rate. If the cam revolves in the reverse direction, the roll will fall accordingly.

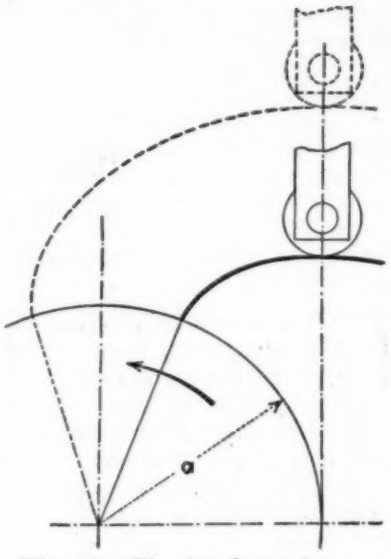


Fig. 19—The involute gives a uniform cam rise

The line which is tangent to the base circle is the line of action or the path of contact. It will be noted that *this line of action is a straight line,* and is therefore symmetrical about any point in this line. This is one of the unique properties of the involute curve which sets it apart from all other gear tooth curves.

Action of One Involute Against Another

If, instead of acting against a cam roll, the involute acts against another involute, we have the conditions shown in Fig. 20. The point of contact between two involutes is that point where the tangents to the two curves coincide. The tangents to both involutes are always perpendicular to their generating lines. The

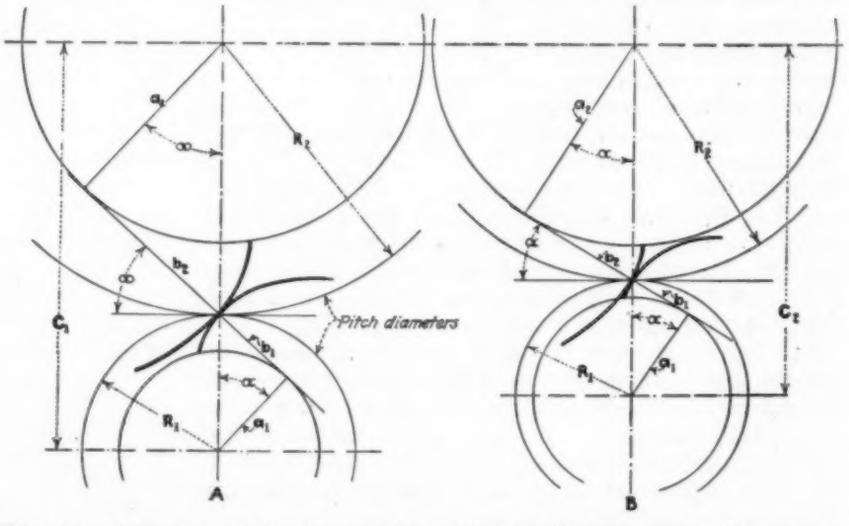


Fig. 21—Influence of the base-circle centerline distance upon the line of action and the pitch diameter for mating involutes

tangents to two involutes in contact coincide only when the generating line of one involute is a continuation of the generating line of the second involute. Therefore, *the locus of the points of contact between two involutes is the common tangent to the two base circles,* as shown in Fig. 20.

When one involute is revolved at a uniform rate of motion, the length of the line of action b_1 from its point of tangency to the base circle a_1 to the involute profile at P, changes uniformly. If the direction of the rotation is in the direction shown by the arrow in Fig. 20, the length of this line increases. At the same time the length of the line of action b_2 from the point P to its point of tangency with the base circue a_2 is shortened at a correspondingly uniform rate, because the total length of the common tangent remains constant. This means that the second involute must revolve at a *uniform* rate in the direction shown by the arrow in Fig. 20.

Base Circles Determine Speed Ratio

The relative rate of motion depends only upon the relative sizes of the two base circles. No matter what the distance is between the centers of the two base circles, when one involute acts against another, contact between them occurs only along the common tangent to the two base circles and their relative rates of revolution remain the same. If the two base circles are identical in size, this rate is also identical for both. If one base circle is double the size of the other, the rate of revolution of the larger involute is one-half that of the smaller. This is because the larger base circle revolves only half as far as the smaller to wind up the length along the line of action that the smaller one has unwound. The conditions are exactly the same as though two pulleys were set up connected by a crossed belt. Thus, *the relative rates of revolution of two involutes, which act against each other, are in inverse proportion to the sizes of their base circles.*

When S_1 = rate of revolution of first involute
S_2 = rate of revolution of second involute
a_1 = radius of base circle of first involute
a_2 = radius of base circle of second involute.

$$\frac{S_1}{S_2} = \frac{a_2}{a_1}$$

The relative rates of the two involutes may be represented by two plain discs which drive each other by friction. Such discs are commonly known as pitch discs, while their diameters are called pitch diameters. *An involute has no pitch diameter until it is brought in contact with another involute.* This is another unique property of the involute curve which sets it apart from all other gear tooth curves. All other gear tooth curves must be developed from a definite pitch line. The involute has no fixed pitch line, but any diameter on it is a potential pitch diameter. *The form of the involute depends solely upon the size of its base circle.*

In Fig. 21 two involutes are shown in contact at different center distances. The common tangent to the two base circles is the line of action. We have seen before that the radii of the base circles are in inverse proportion to the rates of revolution of the involutes. The radii of two pitch discs which represent the same relative rates of revolution must be directly proportional to the radii of the base circles of their respective involutes.

To prove this, in Fig. 21 we have two similar right triangles in which R_1 is the hypotenuse of one while R_2 is the hypotenuse of the other, and a_1 is a leg of one and a_2 is the corresponding leg of the other.

The intersection of the common tangent to the two base circles with the common centerline establishes the radii of the two pitch circles.

The angle between the common tangent to the two base circles and a line perpendicular to their common centerline is called the *pressure angle.* This angle does not exist until two involutes are brought into contact.

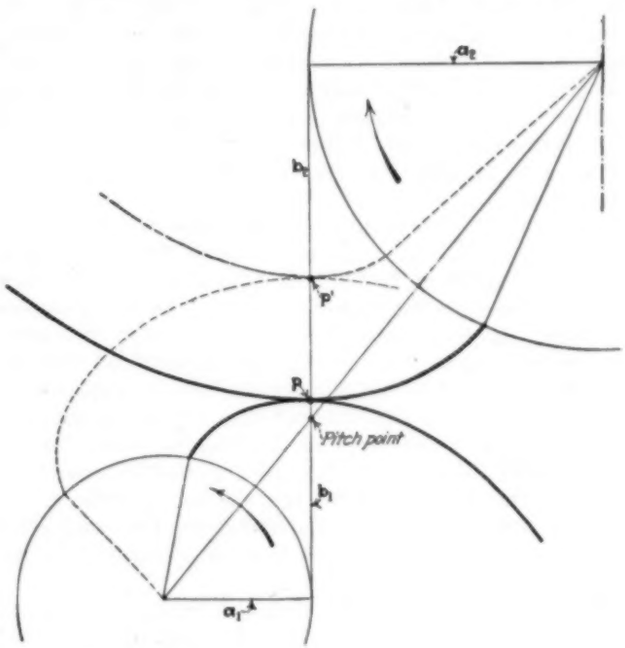


Fig. 20—Action of two involutes in contact

There is a definite relation between the pitch diameter and pressure angle of any given involute. Thus for any established pitch diameter there is a corresponding pressure angle. It will be noted in Fig. 21, that although the same involutes are shown at A and B, they have different pitch circles at A than at B because the distance between the centers is different.

Thus, *both the pitch circles and the pressure angle of a pair of involutes depend solely upon the sizes of the base circles and the distance between their centers.*

When C = center distance

$$C = R_1 + R_2$$

$$R_1 = \frac{a_1 R_2}{a_2}$$

$$C = \frac{a_1 R_2}{a_2} + R_2 = R_2\left(\frac{a_1 + a_2}{a_2}\right)$$

whence, $$R_2 = \frac{a_2 C}{a_1 + a_2} \qquad (16)$$

In like manner $$R_1 = \frac{a_1 C}{a_1 + a_2} \qquad (17)$$

Referring again to Fig. 21, when
α = pressure angle of the pair of involutes, we find

$$\cos \alpha = \frac{a_1 + a_2}{C} \qquad (18)$$

(To be continued)

Book Reviews

Scientific Foundations of Business Administration. By Henry C. Metcalf. Number 4 in the Human Relations Series. Three hundred forty-one pages, 5x8 in. Cloth boards. Cross indexed. Published by the Williams & Wilkins Co., Baltimore, Md. Price $5.

A book for personnel managers, business executives, all who have labor under their control, or for the student of sociology. An intensive study of the human elements of business management through its philosophic, biological, economic, and psychological foundations, written by experts in each subject, and edited by Henry C. Metcalf, author of several previous books dealing with the intricate problems of labor management.

The twenty-two chapters of the book are filled with startling but convincing conclusions. From the philosophic standpoint Dr. Carver says that "the greatest cause of waste is the narrowing of the stream of human energy." He goes on to show that under the free labor capitalistic system the world has progressed further in 150 years than in all previous times under other systems. Chapter XII adds to this the statement that "Capital and labor must fight or unite," and follows that capital has "power with" rather than "power over" labor. The book is timely, and the better understanding of the subject by both employers and employees ought to minimize the waste from labor disagreements.

The Locomotive. Bound volume XXXV, covering the years 1924 and 1925. 250 6x9-in. pages. Published by the Hartford Steam Boiler Inspection and Insurance Co. of Hartford, Conn. Price $3.

This little magazine, published quarterly by the above company, is too well known to require extended notice. For thirty-five years it has been carrying the gospel of protection and accident prevention. The present volume is quite up to the standard of previous years.

Electrical Trouble Shooting on the Motor Car. By A. H. Packer. 463 5x8-in. pages. Full index. Published by A. H. Packer, 8115 Harper Ave., Chicago.

A rather complete textbook on the subject of electricity and electrical appliances incidental to the automobile, written in language that is easily comprehended by the non-technical seeker of information, whether car-owner, garage proprietor or repairman. It opens with a chapter on wiring, showing diagrams of the manner in which electric current is distributed to the various units, inducts the student into the mysteries of ignition systems, storage batteries, starting motors, generators, etc., and closes with a chapter upon business management for the proprietor of the small shop who is engaged or desires to engage in the repair of this class of equipment.

There are 41 chapters, each covering a single phase of the subject and showing by diagram and illustration not only the theory of operation but the actual construction of many of the standard appliances now on the market and giving detailed information as to the manner of locating a trouble as well as the method of making the repair. Supplementing each chapter is a list of problems suggested by the text, upon which the student may test his newly-acquired knowledge. Answers to all problems are given in the back of the book.

While not purporting to be an automobile book in any sense other than covering the electrical features, it does, of necessity, go somewhat into the theory and construction of the gas engine in its treatment of ignition systems, of the Bendix and other mechanical drives in connection with starting motors, and of transmission gearing to which electric gear-shifts are applied. The book is equally adaptable to individual study or to be used as a textbook in trade schools.

Proceedings, Twenty-Eighth Annual Meeting, American Society for Testing Materials, Vol. 25, Parts I and II. Nine hundred sixty-two pages, and four hundred and fifty-four pages, respectively, 6x9 in. Heavy paper, cloth, or half leather binding. Tables, diagrams, charts, and illustrations. Cross indexed. Published by the American Society for Testing materials, 1315 Spruce St., Philadelphia, Pa. Price $6 in paper, $6.50 in cloth, or $8 in half leather.

Part I contains the reports of committees and subcommittees on a variety of subjects such as: Tests of Metallic Coatings; Cement Testing; Paint Tests; Lubricants. It also contains the full detailed specifications adopted tentatively as standard for a large number of products.

Part II comprises abstracts or synopses, with their respective drawings, charts, and tables, of the papers submitted by members of the Society. Among those bearing on the machinery industry are: The Tensile Properties of Metals at High Temperatures; Fatigue of Metals by Direct Stress; Softening of Copper; Evaluation of Corrosion Tests.

The two volumes constitute an important addition to the published data on standards as determined by practical tests.

Tolerances, Allowances and Gages for Metal Fits. Tentative American Standard, approved by the American Engineering Standards Committee, 29 West 39th St.. New York, N. Y. Price 50c. This booklet is devoted to the nomenclature and classification of machined fits, including allowances and tolerances for interchangeable manufacture; and to the fixing of standard tolerances of plain limit gages. The fundamental conditions on which the tolerances are based are set out and the various terms used are defined. Illustrations are used in the classification of various gages. Tables list the allowances and tolerances for various classifications of fits, which are eight in number.

Thermal Expansion of Tungsten. By Peter Hidnert and W. F. Sweeney. Scientific paper No. 515, pp. 484-487, inclusive, of Vol. 20. Published by the Bureau of Standards, Washington, D. C. Price 5c. This paper gives the results of an investigation on the thermal expansion of tungsten (99.98 per cent) over various temperature ranges between —100 and +500 deg. C. A summary of available data obtained by previous observers is included. The report forms an important contribution to the subject.

Soldering, Brazing and Riveting Sheet Metals

By A. Eyles
Manchester, England

Preparations for soldering—Fluxes and their use—Composition and melting points of solders—Use and care of soldering coppers—Strength of soldered joints

WHILE almost every branch of mechanical engineering has been well provided with literature in technical journals, singularly, little has been published with regard to the methods employed for jointing sheet metals. By the term "sheet metals," is meant those metals and alloys which are used in thin plates and sheets.

Soldering is the art of joining the surfaces of similar or dissimilar metals by partial fusion and the insertion of a metallic alloy or mixture between the surfaces called solder, it being more fusible than the metals which it unites. The inherent qualities of a good solder are determined by the constituent elements entering into its composition. In order to fulfill its proper function, the solder must be hard, tenacious, and free-flowing.

Soldering can be used where either brazing or welding would be unsuitable.

While soldering is comparatively simple, it requires care and skill. Following the directions in this article should go far toward enabling the mechanic to master the art

In order that metals soldered together may be securely held, it is necessary that there must be more than mere adhesion between the solder and the metal. There must be an alloy formed between the metal and the solder. In order that this alloy may be formed, the surface of the metal must be entirely free from any foreign substance as oxides, oils, or various solid matters. The rapidity with which a soldering flux acts is an important factor in its usefulness. Chloride of zinc has several properties which make it a valuable soldering flux for most work, since it remains liquid at the temperature of melting solder, thus being in a condition to act upon the oxides very readily. Resin should not be used as a flux where speed is required, as it has the undesirable property of leaving a sticky, gummy, mass on the surface of the sheet metal.

There are many soldering fluxes in practical use, and each has its advantages and disadvantages. Chloride of zinc, hydrochloric acid, ammonium chloride, resin, and tallow are the fluxes mostly used. Chloride of zinc is used as a flux when soldering tin plate, tinned steel, terne steel, monel, nickel, brass and copper sheets. Tallow or resin is used when soldering block tin and lead sheets. Hydrochloric acid is used for zinc and galvanized iron sheets. Stearine may be used when soldering aluminum.

A good flux should facilitate the flow of solder; it should prevent oxidation of the metal; it should be capable of easy application.

Chloride of zinc is readily made by dissolving clean, scrap sheet-zinc in hydrochloric acid until effervescence ceases. Be sure to provide an excess of zinc, observing that a quantity remains undissolved after all chemical action ceases. The acid receptacles should be set outside the shop, so that the fumes will not be inhaled by the workmen. After chemical action has ceased, it is best to allow the flux to stand for a few hours before using, and it is advisable to filter it through several thicknesses of cloth. Add no water to this flux, for the stronger it can be made the better it will be.

The best-quality soft solders are made from virgin lead and virgin tin, both of which can be obtained practically pure in commercial quantities at market prices. Soft solders can also be purchased from reliable dealers. Experiments recently carried out with a view of tin conservation in tin-lead solders, have shown that in many cases either lowering the tin content per se, or substituting or adding other metals, will not render the solder less fit for its intended use. On several occasions the writer has witnessed soldering operations performed much more rapidly with a 40-per cent tin and 60-per cent lead solder, when worked at the proper soldering temperature and with proper fluxes, than when a 60-per cent tin and 40-per cent lead solder, improperly employed. The principal constituents of solder are tin and lead, but much depends on the percentage composition. Some peculiar and even surprising results can be obtained by alloying varying proportions of tin and lead together. Thus, although the melting point of lead is 621 deg. F., and that of tin 450 deg. F., when these two metals are alloyed together in equal proportions to form ordinary solder (half and half), the melting point drops to about 370 deg. F., while a solder containing 66 per cent tin and 34 per cent lead, melts at about 350 deg. F. Fusibility is an important

First part of the article. The second part will be published in an early issue.

point, but it should be borne in mind that a low degree of fusibility in solder can be obtained in other ways than by increasing the percentage of tin. A solder containing 20-per cent tin, 30-per cent lead and 50-per cent bismuth, has a melting point as low as 212 deg. F. Most sheet-metal workers prefer solder of a high percentage of tin because of its easy flow. However the 50/50 solder appears to have become standardized because it is the most effective compromise. Cadmium is a promising substitute for part of the tin in solder. Many cadmium solders have been made and tested on a practical scale, and tests show that the compositions given in Table I give good results for many of the purposes for which solder is required.

Table I—Solders Containing Cadmium

No.	Cadmium Per Cent	Lead Per Cent	Tin Per Cent	Zinc Per Cent
1	10.0	80.0	10.0	....
2	10.0	85.0	5.0	....
3	10.0	90.0	....	....
4	7.5	85.0	6.0	1.5

Although soldering coppers may be heated in any fire, it is better to avoid the dirt, smoke, and tarry substances found present in a bituminous-coal fire. Various types of stoves and furnaces for heating soldering coppers are made to burn gas, oil, coke, and charcoal. Of late years several varieties of soldering coppers, heated by electricity, gas, gasoline, and acetylene, have come largely into use.

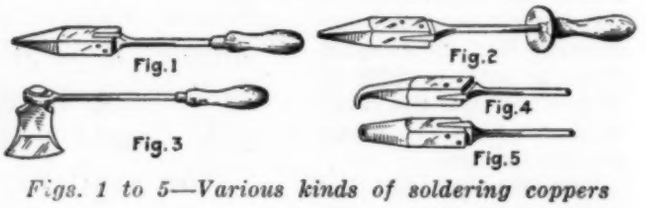
With an electrically heated soldering copper there is no necessity for having a large tool for heat storing purposes, since the heat is supplied internally and continuously by the electric current. Care must be taken, however, in using electrically-heated soldering coppers, since they will not stand rough usage. Another point to be remembered is that these tools should be kept free from acid fumes as far as possible, and when using chloride of zinc flux, care should be taken to use only as much as is necessary. Soldering tools requiring from 50 to 100 watts are suitable for very light work, and from 300 to 350 watts for soldering heavy sheet metal work. Generally, an air-acetylene soldering tool consists of a blowpipe of the bunsen type so that the flame plays upon the soldering copper and raises it to the required temperature. The soldering copper is usually made in cylindrical form, enabling the flame to surround it, thus giving the maximum retention of heat in the body with low flame velocity and small gas consumption. For continuous work, the requisite heat is maintained with the reduced flame, which makes the use of this type of soldering tool very economical. Considerable economy can be effected by the use of electrically, coal gas, or acetylene and gasoline-heated soldering tools, since frequent retinning of the copper is not necessary as with fire-heated tools.

Furthermore, with these modern soldering tools one copper only is necessary for soldering operations, whereas it requires two ordinary coppers (one being heated while the other is being used) to avoid loss of time. Soldering coppers of different sizes and shapes should be included in every shop equipment. A small soldering copper should not be used on large or heavy work, since it cannot hold sufficient heat to allow the solder to flow and sweat into the joint as it should. When a small soldering copper is applied to sheet-metal work of large or heavy section, the heat is conducted from it quickly and it becomes cool and renders the joint ineffective.

Forged soldering coppers are better heat retainers than soldering tools cast from ingots. Fig. 1 shows the ordinary pointed soldering copper for general work. Fig. 2 shows a soldering copper fitted with a disk shield for protecting the hand when effecting vertical or overhead soldering operations. The shield is fitted against a small shoulder turned on the stem and the latter is threaded to screw into the handle. This permits quick removal of the shield for carrying in the tool kit, or for soldering operations where it would not be needed. Fig. 3 represents a hatchet soldering-copper. Fig. 4 shows a bent or curved soldering copper which is extremely useful for repairing automobile radiators of the tubular type. This soldering tool enables the operator to reach many points of radiator and other work, inaccessible with an ordinary soldering tool.

A special soldering copper designed by writer for soldering over the tube ends on radiator-header plates is shown in Fig. 5. For this work the soldering copper should be made about 15 in. long, inclusive of shank and wood handle. At the end it is approximately 1¼ in. outside diameter and has ½-in. hole. This tool, resting on the header plate in a vertical position and given a rotary movement, affords good results. A useful type of soldering copper for outdoor work, is the gasoline-heated one. It can be used either as a soldering copper or as a blowlamp.

Before a soldering copper can be used effectively, it must be tinned. That is, the points or slopes must be coated with solder. A good method is first to heat the



Figs. 1 to 5—Various kinds of soldering coppers

soldering copper to a dull red color, then file it bright on four sides, not higher than three quarters or one inch from the point. This gives a bright, smooth surface on the part of the copper to be tinned. If the copper is sufficiently hot, briskly rub the filed parts on a "Salamac" (muriate of ammonia) block and melt a small portion of solder into the cavity of the block, then rotate the copper upon the solder and "Salamac." By this method the soldering tool will become tinned almost instantaneously. Fig. 6 shows an arrangement designed by the writer, whereby the customary loss of surplus solder during the tinning operation is saved. It is made from copper scrap ⅛ in. thick, and consists of a rectangular tray 6½ in. long, 4½ in. wide, and 1¼ in. deep, with a block of "Salamac" encased with sheet copper, the latter being soldered to the bottom of the tray. "Salamac" is practically of the same strength, chemical composition and purity as the best sublimed salammoniac, and is efficient, economical and more easily handled substitute for the latter.

When heating the soldering copper, care should be taken not to allow it to reach too high a temperature and if by chance it should be left in the furnace long enough to become red hot, it should be allowed to cool down before using. In the manipulation of the soldering copper, it should be the aim of the mechanic to so use it that its point or face remains tinned, because retinning in-

volves loss of time and frequent filing quickly wears it away.

It is very essential in all soldering operations, that the parts to be united should be perfectly clean and free from metallic oxides. This cleanliness should be both mechanical and chemical. Mechanically clean the surfaces by scraping, filing, or grinding, and before the air has time to oxidize the clean surfaces, chemically clean them by applying suitable fluxes. Practically all sheet metals can be successfully soldered when correct methods and materials are employed. The method of procedure

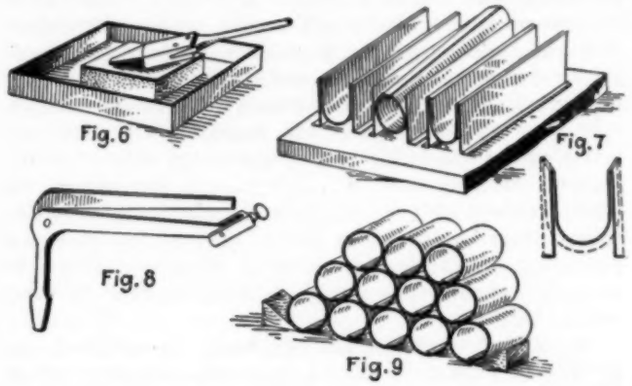


Fig. 6—Tinning the soldering copper. Fig. 7—Holding irregular work. Fig. 8—Tool for holding longitudinal seams. Fig. 9—Cylindrical articles arranged for soldering internal seams

in both new and repair work is practically the same. The only difference between the two, is that it generally necessary to spend more time on repair work in preparing the surfaces to be joined by scraping or filing. Scraping is the best method and is usually done by means of steel scrapers of varying shapes and sizes to suit the work in hand.

Sound soldering cannot be produced unless the sheet metals are brought to the same temperature where they are to be jointed together. Consequently, when soldering material of thin sections to thick sections, it is necessary to hold the soldering copper for some time on the latter before attempting to solder the thin metal to it. The reason for heating the thick metal first, is that by reason of its bulk it takes longer to reach the proper soldering temperature. In other words, the rapidity with which the heat from the soldering copper is dissipated, soon brings its heat below the working point. Not infrequently, when soldering thick or massive sheet metal work, it is necessary to employ an atmospheric blowpipe or blowlamp flame to heat up the parts to be soldered, since the soldering copper alone cannot carry sufficient heat to the work. When soldering aluminum, brass, copper or steel, the surfaces to be joined together should be first tinned. This can be done by heating the surfaces to a temperature somewhat above the fusing point of the solder used, and rubbing molten solder upon the clean surface with the point of a well tinned soldering copper. The surfaces are then pressed or clamped together and again heated, and more flux and solder used, until the joint is thoroughly sweated. Always remove all traces of flux from finished work to prevent corrosion. This may be done by washing with soda water.

Not infrequently, the art of joining sheet metals without using a soldering copper produces very strong and neat results. The method is to employ the flame of an atmospheric-gas blowpipe or blowlamp to the parts to be soldered, until they are just hot enough to sweat in the solder, and not hot enough to make the solder roll off. A continuous and steady flame is desirable. The secret of this kind of soldering is to know when the correct soldering temperature is obtained. After a little practice, it can readily be accomplished. The work must be arranged so that the surface to be soldered is practically horizontal. Imagine a flange being soldered to a tinned-steel tank. Swab the joint with flux, then play the flame on the edge of the flange. Sufficient temperature will be reached in a few seconds. Move the flame three or four inches further along the flange and at the same time apply the solder to the heated part. Overheating the surfaces to be soldered must be avoided. Should the parts get too hot, apply flux with a brush to cool the metal, then apply the solder to the section which is at the correct temperature. The method for soldering seams in cylindrical sheet-metal work is the same. Apply the flux, heat, move the flame on, apply solder to the parts last heated, and as the solder flows in, move the flame still farther on and apply solder quickly where the flame left. If any great length of seam is being soldered, the work should be slanted in the direction the solder is required to flow.

Ingenious appliances or jigs, are often devised to effect soldering operations, both uniformly and expeditiously, since much trouble can be saved in final adjustment by having a good and simple method of holding parts that are to be soldered. An improvised device for holding parts of irregular shape, when soldering longitudinal seams, is shown in Fig. 7. The parts are made from perforated zinc sheets, 0.018 in. thick. The device enables six pieces to be soldered at one operation, that is, without reheating the soldering copper. They are first tacked at both ends before soldering the seams. The tool shown in Fig. 8, commonly known as soldering gibbet, is used for holding the longitudinal seams in position on cylinders when soldering.

A good method for arranging cylindrical articles (such as oilcan bodies) when soldering internal, grooved seams is shown in Fig. 9. By this method it is possible to solder twelve one-gallon oil-can bodies without reheating the soldering copper.

Selection of the Solder

The strength of soldered joints varies widely with the composition of the solder; with the method of making the joint; and with the kinds of metals joined. In a number of tests made on different compositions of solders, it was found that a solder containing 60-per cent tin and 40-per cent lead, having a Brinell hardness of 14.6, was the most suitable for general work in which considerable mechanical strength is required. In a series of joints made on copper and brass, with solders containing from 40- to 70-per cent tin, practically all of them broke at loads under 13,000 lb. per sq.in. The maximum strength on copper was obtained with 60-per cent-tin solder, the strength declining with a solder containing higher tin percentages. This peculiarity of copper is thought to be due to the difficulty of maintaining the proper temperature in soldering, since with a slight excess of heat, the extreme fluidity of the high-tin solder causes it to run out of the joints. With brass, on the other hand, the strength

increases as the proportion of tin in the solder is increased. In further tests to determine the life of soldered joints under light loads, it was found that joints on brass have longer life under a given load than those on copper. The maximum strength obtained was 25,000 lb. per sq.in. in the case of a joint on copper, with 60-per cent-tin solder. For a solder required to stand resistance to stress and one more suitable for general work, 60-per cent tin is the best possible combination, but for work requiring little mechanical strength, a much lower percentage of tin can be used successfully. The tensile strength of a good aluminum solder is about 7,000 lb. per sq.in. Those with higher tensile strengths become completely liquid at a temperature too high to allow them to be used for soldering purposes.

Industrial Accidents

By E. Andrews

I READ with interest the abstract under the title, "Industrial Accidents," published on page 367, Vol. 63 of the *American Machinist*, because I have had considerable experience in safeguarding machinery and in other accident prevention work during recent years in various engineering plants.

At the outset, it can be safely said that there has been a marked change for the better during the past few years in accident prevention; also, the way has been pointed out by safety inspectors, engineers, and safety committees to a still further reduction of the number of industrial accidents.

In many plants records have been kept showing the importance of safeguarding machine tools and transmission machinery, and on account of the steps taken in this direction the percentage of accidents resulting from such causes as unguarded gears, belts, shafting and projections on revolving parts has been materially reduced. Although only a small proportion of shop accidents is directly attributable to inefficient guarding of machinery, experience shows that such guarding not only tends to avoid such accidents as being trapped in machinery, but also helps to keep the matter of safety before the employees; furthermore it indicates a willingness on the part of the employer to do his full share toward preventing industrial accidents.

Employers who adopt systematic methods of recording and compiling accident statistics and who exhibit such records in prominent positions in their shops with the viewpoint of catching their employees' attention can be considered pioneers in industrial accident prevention. It is obvious that the reduction of accidents depends first of all upon the employer, since it is of little use to preach safety to employees who work at or around unsafe machinery, and in unsafe places. True safeguards cost money, but the compensation paid for a life, loss of a limb, or an eye, would buy many guards for dangerously exposed gears, belts, and projections on revolving parts.

On the other hand, the responsibility of the employer does not end with the provision of guards against mechanical hazards; accidents will happen, after all precautions have been taken to safeguard both machine tools and transmission machinery, through carelessness or ignorance of the employee. The effects of carelessness in industrial establishments are far-reaching and are continually felt in every shop, no matter how small or unimportant it may be. Involving, as it does, the human factor, it is a difficult matter to take precautionary steps which will help to minimize the effects without first analyzing the conditions which are responsible for the trouble. A prominent industrial surgeon once remarked that employees frequently injured themselves with apparent deliberation, since the movement that produced the injury was a unit in the habit series; that the more highly skilled an employee became, the more liable he was to a lapse of attention, accompanied by unconscious activity. It would appear, therefore, that one solution of the problem of injury to an employee due to carelessness, would be to change his environment in the shop occasionally. To allow an operator to work too long at one machine with only one series of actions tends to jeopardize his safety. Carelessness on the part of employees is considered the larget element in preventable accidents, being rated by some authorities at about double that due to inefficient guarding. A careless operator is often in trouble; he is inefficient, and frequently injured; he fails to think before he acts.

As regards power press accidents, the number and severity of these accidents have considerably fallen; this fact is due to the improved standard of guarding now being insisted on. Not infrequently, however, we hear the statement made that up-to-date guards for power press tools retard production. Unfortunately, this argument is used by employer and employee alike with equal insistence in some plants. The writer's observations and experience lend no support to this view. In the majority of instances where the adoption of modern automatic press guards have been put in operation a precisely opposite effect has been the result, doubtlessly due to the press operator's feeling of greater safety.

Danger in Woodworking Machines

Modern woodworking machinery is exceptionally hazardous. It should, therefore, receive special attention and every effort should be made by employers to provide adequate and effective safeguards. Even when properly guarded, woodworking machines are always a source of danger for the reason that they cannot be made entirely foolproof. A thoughtless movement, or the lack of close attention to the work for a fraction of a moment may result in the loss of several fingers or a hand, since these machines are invariably operated at high speeds. The vertical spindle-molder, or shaping machine, is thus one of the most dangerous woodworking tools in common use and is the cause of a large number of accidents yearly, a considerable proportion of which result in the loss of several fingers. As with circular saws and overhand planers, the reason lies mainly in the operator's hands being constantly in close proximity to rapidly moving, sharp-edged tools. The fingers may come into contact with the cutters, especially when the work is violently torn from the operator's grasp in consequence of some irregularity in the work. Fatal accidents are sometimes caused by the cutters breaking off, or coming loose, and being hurled away with considerable force due to the high velocity of the spindle. It is therefore of prime importance to provide the most efficient guard to the cutter of every vertical-spindle molding machine that is consistent with the nature of the work which is being performed.

Woodworking machinery operators require careful and expert instruction in the use of their machines and the safeguards provided and in the safer methods of working. In assigning employees to woodworking machines regard should be had to their personal characteristics. Dilatory and clumsy employees should not be put to work at high speed woodworking machine tools, nor should reckless and inexperienced youths be employed at dangerous machines. Much depends upon choosing foremen endowed with caution and an intelligent regard for accident prevention. Success in accident prevention in our industrial plants depends very largely upon the co-operation between the foremen and the employees and the display of interest in their welfare. They should be led in a reserved manner and made to follow such safe practices as will effect a reduction of accidents and the development of a better organized force.

This contribution would be regrettably incomplete if it failed to call attention to the need of protection for the eyes of industrial employees. Where there is a possibility of flying particles, such as metal chips, molten metal, emery dust and flying scale, entering the eyes, employees should be provided with safety goggles suitable for the work in progress. Unfortunately, there are many workers who discard safety devices provided for their benefit. This is a difficult problem to deal with as it is almost impossible to understand the attitude of mind of the employees who, are provided with safety goggles to protect their eyes and who risk the loss of their eyesight rather than wear them. Employers should make goggle wearing compulsory on jobs subject to eye hazards.

Is Engineering Education Too Technical?—Discussion

BY ENTROPY

The editorial, "Is Engineering Education Too Technical?" which appeared on page 1060 of the *American Machinist*, Vol. 63, No. 27, is certainly worthy of some thought.

Engineering graduates go into a very great variety of jobs, and a few positions. The engineering schools cannot offer any considerable number of specialized courses, and they ought not, for their graduates go not only into a large number of jobs, but also into several quite diverse jobs before they settle down for their life work.

It seems to me that the greatest difficulty that graduates meet is where they have to take places which require only a small fraction of the knowledge they have acquired, and by the time they have matured so that they are entrusted with real engineering problems, everything, except fundamental principles, has changed.

Look over the course of study of any engineering school today, then compare it with that of the same school twenty-five years ago. The astonishing thing is that so much is the same. Of course, they must teach principles, and those do not change. A few mathematicians take a text book on strength of materials and dress it up with more calculus, or less, and it is a new text book, but if the instructor is wise he teaches the same things that were taught years ago, and he teaches them in a simple way so that the pupil understands them. Later, if he wishes, he may surround these same principles with mysterious data in order to watch the boys struggle with the problem to see what data may be essential and what is just thrown in to make the problem interesting.

Therefore, may I suggest that engineering schools offer their undergraduates nothing but fundamental principles, illustrated by problems taken from actual current practice, and then offer their graduates extension training, resident or by correspondence, in the special things which they find need of in each job that they later encounter. In this way each man would graduate with all that he really can use, and he could get whatever he finds that he needs. For example, suppose a man graduates next June; by a year from that time he will have rubbed off some of the sharp edges, and someone will consider him sufficiently tamed to put him on the design of heavy foundations. He will need more technical information than is offered in any engineering school; he will need it quickly. Let his school welcome him back for a short time in the laboratory and send him for a longer time lessons by correspondence based on one or more standard text books. The next year he may need to know more about the design of bearings than he could have obtained in any regular course. Let him come and get whatever the school cannot mail out, consisting mostly of laboratory work, and in that way he can put himself abreast of the times.

TEACH THE MATURE MIND

There are objections to such a radical change, one being that the faculties of the schools would have to be reinforced by professors who are alive and up to the minute or, what is simpler, would have to enlist the aid of graduates who are anxious enough to help their alma mater that they would do this work for the good of the school and their fellow graduates for a nominal sum.

The above is probably altogether too radical a suggestion to take root at once, but with the growing knowledge of things technical, the time came long ago when no one man could know all that is to be known about even a simple subject. That being the case, why not specialize on the job and at the same time that the work is going forward? More than that, why not leave this deeply technical stuff until the man is mature enough to grasp it and hold it? In the formative stage, at which boys now attend college, there is time for an all-around, well-balanced education. These graduates have to go out and live in the world with a lot of fellow men. Why not teach them the same language so that when they associate with academic men, with legal lights, or with theologians, they will be able to make themselves understood? Why conceal the elements of finance, of accounting, or of sales from embryo engineers? If we hold to the elements, there is time enough for all this. Why not teach them enough Latin to know a few root words and enough literature to know what to appreciate? Why not give them a little knowledge of practical politics? This period, now spent in engineering schools, is the only period that most men get in their lives when they can take the time to really think things out. Let them have a chance to think out their ideals and their relations to the rest of the world. Engineers would manage the world if they adapted themselves to society as it *is*, rather than herding themselves into a corner over a drawing board in order to send out a drawing of something that they hope someone will finance and sell.

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

A Home-Made Cam Cutting Machine

By Milton Wright

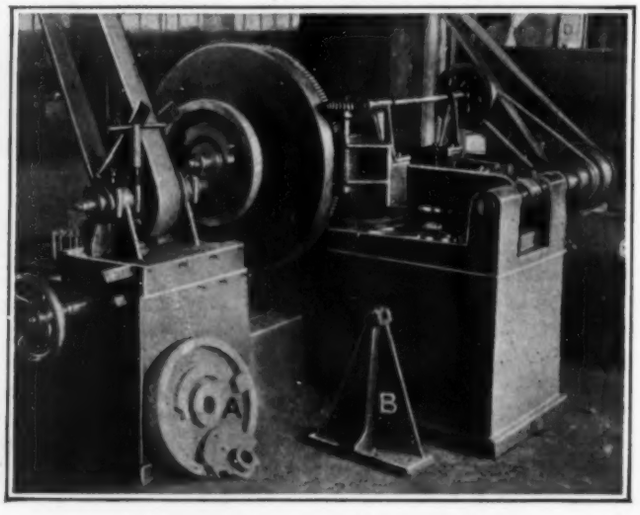
The Fenn Mfg. Co. of Hartford, Conn., builds a line of special machinery for which many face cams of different sizes and shapes are required. To duplicate these cams, the machine shown in the accompanying illustration was built in the shop by the company's own workmen.

The machine was never "designed"; it is an evolution. In fact the base, which is a rather large and rigid casting, was about the last part to be added, and that only after the machine had been in successful operation for a long time.

The machine as it now stands, consists mainly of a longitudinally adjustable headstock, in the spindle of which any kind of an end mill having a tapered shank may be used. It also has a work-carrying spindle mounted in bearings at the end of a vertically swinging member that pivots about the driving shaft at the extreme right.

An essential part of the machine is a master cam that is a duplicate in contour and size of the cams to be produced. Some of these cams are as large as 4 ft. in diameter. For comparatively long runs, where there are fifty or more cams of a kind to be made, the master cam is bolted to the back of the large faceplate, and bears upon a fixed roller that is directly in line with the cutter spindle and of the same diameter as the milling cutter in use.

Large master cams are made in two or more parts, with jig-drilled bolt and dowel holes, so they can be put in place without dismounting the work spindle. Small cams, or master cams that are to have but few duplicates, may be bolted directly to the large faceplate behind the work piece. Such a master, with the cam it produces, may be seen at *A* in the illustration. When the master cam is in front of the faceplate, it bears upon the roller of the bracket *B*, which is attached to the base of the machine with its roller in line with the cutter.



Home-made cam cutting machine

Since the driving shaft is the center of swing of the work-carrying member, it may be belted directly to the line shaft above. From it a return belt, running over a pair of cones to provide changes of work speed, drives the feeding mechanism. This latter consists of a double, worm and wheel reduction-train, which, as it is all in plain sight in the picture, needs no explanation. The teeth of the final wormwheel are cut directly in the periphery of the faceplate.

As the work spindle revolves, the whole member swings up and down as the contour of the master cam travels over the fixed roll. The fact that it swings in the arc of a circle makes no difference, since the position of the fixed roll with relation to the master cam is always the same as that of the cutter to the work.

To relieve some of the strain upon the roller, the swinging member is partly balanced by a counterweight suspended by a wire rope that passes over a sheave in an overhead timber. The counterweight is made like the weight of a weighing scale, so that it may be added to or subtracted from in accordance with the size and weight of the work piece.

When set up, the machine runs practically without attention, except for changing the work pieces as they are completed.

That Odd-Sized Bushing—Discussion

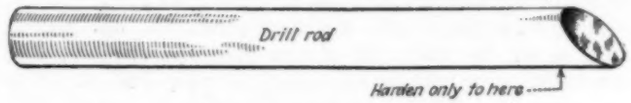
By Amos Ferber

I do not think the method adopted by H. W. Myrick to make an odd-sized drill bushing, described on page 965, Vol. 63 of the *American Machinist*, is a good one. To make an excellent reamer that is a few thousandths under a standard size, is the work of but a very few minutes, and no chances need be taken.

Toolrooms now-a-days usually have a plentiful supply of drill rod of various sizes, and Mr. Myrick probably could have found in the rack a rod of 0.120 in. diameter or whatever size he considered necessary to allow for lapping the bushing. If not he could have reduced a standard $\frac{1}{8}$-in. rod to the desired size by putting it in the chuck or collet of a bench lathe and polishing it with abrasive cloth.

Having found or made a rod of the desired size, he could next take a file and dress off the end of the rod to an angle anywhere from 45 to 60 deg. with the axis, harden the tip end of the rod and ream out his bushing; all in little if any more time than he used up in his experimental hardenings.

Many people do not know that this simple expedient will make a reamer capable of removing a few thou-



An emergency reamer

sandths of stock and leaving a superior finish in the hole. The trick is in hardening only the extreme end of the rod. To harden further back than is necessary to set the cutting edge is to destroy the clearance and render the tool useless.

A Portable Cleaning Tank

BY P. H. WILMARTH

The common shop problem of cleaning the slush from machine parts, as taken from the stock room; the oil left in gear boxes after running in; and the complete removal of dirt from machine parts, not reached by compressed air or wiping cloths, was solved in our shop by building the portable cleaning tank illustrated.

The tank was made of 11-gage sheet-steel, electric welded, and was constructed with legs so that the complete tank centered on the plank top of a Cowan trans-

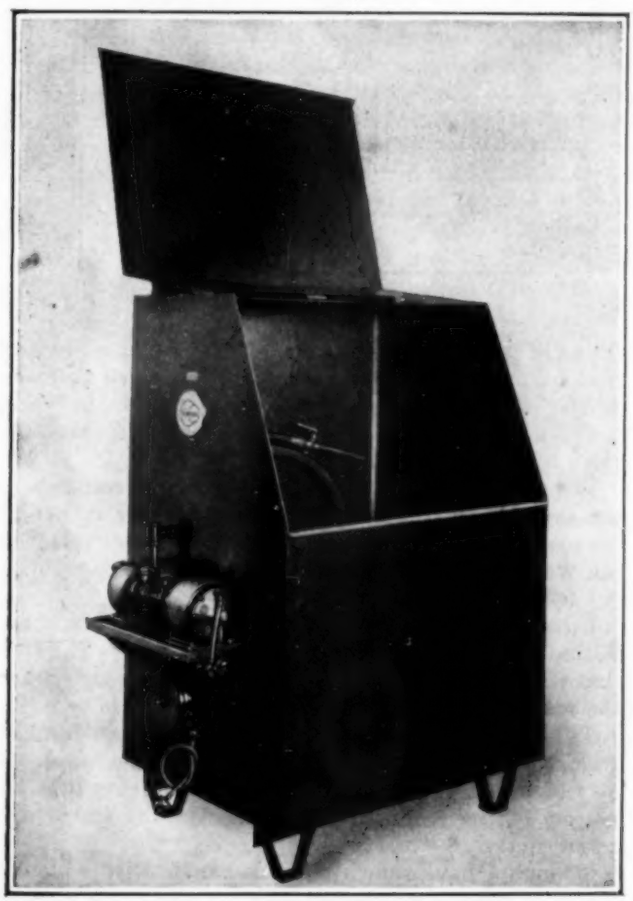


Fig. 1—Portable cleaning tank

veyor platform, without having to bolt it down or drill any holes through the side or bottom. The tank is 30x40 in. and is 30 in. high up to the front opening. The overall height is 54 in. The back and sides serve as effective splash guards, and the hinged top allows for keeping the tank closed when not in use. The top is hinged back of the center to allow for washing and draining a load suspended from an overhead crane or hoist, over the center of the tank. Inside of the tank is a steel table 28x38 in. and 15 in. high with five 1½-in. flanged pipe legs (one at each corner and one in the center), to distribute the load in case very heavy parts are put or dropped on it. The table top is ⅜-in. boiler plate, perforated with 1½-in.

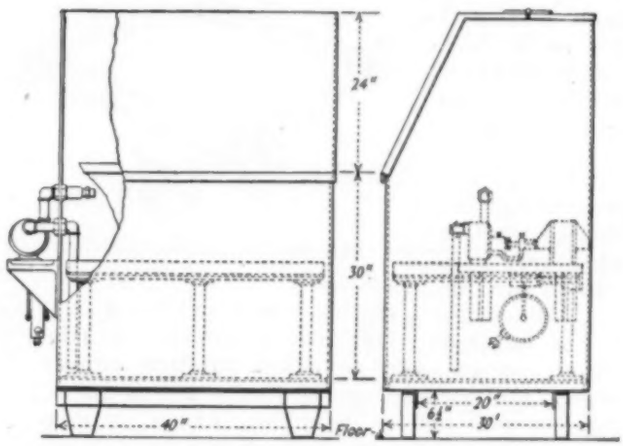


Fig. 2—Details of the tank

holes about 2¼ in. on centers. There is also a 2x2x¼-in. angle-iron rim around it, to keep small parts from rolling off into the bottom of the tank.

The outfit is kept filled with about 60 gal. of kerosene, although most any cleaning solution could be used as occasion required.

A bracket on the end of the tank carries a type AC2-4 Fulflo pump (always primed), which is direct connected to a 110-volt a.c. ¼-hp. Westinghouse motor. A General Electric motor-starting switch, type CR-1047 A1, is conveniently located directly under the motor, and a style 1523 Reelite, containing 25 ft. of extension cord, makes it possible to plug the motor in at any light socket. The discharge of the pump is fitted with an 8-ft. length of ¾-in. metal-lined gasoline hose, and a lever-handle cock controls the flow through a flattened pipe nozzle.

The dirty kerosene from the tank is put through a De Laval oil purifier as often as necessary to keep it free of chips, filings, grit, water, and other foreign matter.

Repair men and millwrights will appreciate the portability of this unit, since it can be taken to any part of the shop or garage.

Many visitors and fire insurance inspectors have commented upon the outfit as a decided improvement over the usual method of using an open pan, a stub of a brush and plenty of oil-soaked rags or waste.

The entire outfit was built at the works of the Blanchard Machine Co., and cost approximately $150 complete.

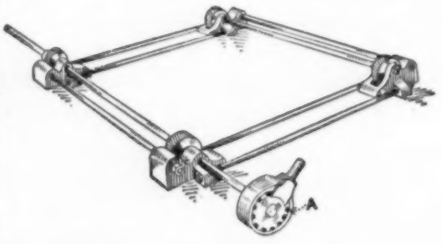
Forgings shrink about 0.01 in. per inch both of length and thickness. This means that for a forging 2 in. thick, each half of the die would have a depth 0.01 in. greater than one-half the thickness of the forging.

A Valve-Setting Device

By Louis Reibel

In setting the valves of locomotives, it is necessary to turn over the driving wheels many times in order that the movement and position of the valves can be determined.

We formerly pinched the engine along the track, but it took a lot of help and was a very slow process. In using the device shown, the engine is jacked up and the sections of track across the drop pit are removed. The device is placed across the pit so that when the engine is lowered the main drivers rest on the four rollers having spiral grooves in them. By using a lever in the ratchet *A*, one man can turn the wheels, though we usually have two men on the job. The ratchet is removable and can be used on either end of the shaft. The pawl is reversible so that the wheels can be moved in either direction without removing the ratchet from the shaft. The device is tied together with rods so the driving wheels can drop between them, and the fore and aft distance between the rollers is such that when the wheels are resting on the rollers, the crank pins will have clearance above the tie rods.



Device for setting valves

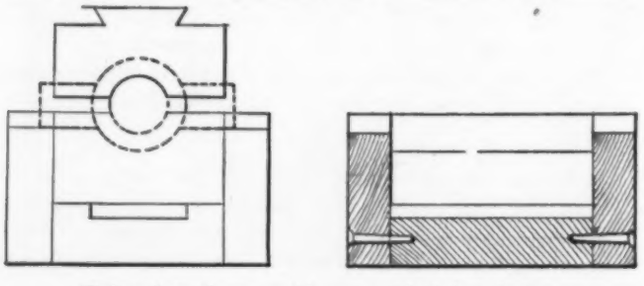
Making Special Chuck Jaws from a Plaster Model

By B. J. Stern

A small jobbing shop often uses unorthodox devices to assist in turning out its work. A good example of such practice occurred in a small shop that was a combination of brass foundry and machine shop, in which the writer was once employed, and which did a good deal of jobbing work on small odd-shaped brass castings such as special valves, plumber's hardware and similar parts.

The general practice followed by the shop to hold these awkward pieces for machining them was to make up a set of steel, false jaws for a box chuck that was mounted in a small turret lathe. Often, however, the number of castings in a lot would be too small or the work would be in too much of a rush to warrant such elaborate measures.

In such cases a plaster-paris mold of the false jaws would be made as shown in the illustration herewith, by using a sample of the casting to be machined as a model.



False jaw from pattern molded in plaster

A wooden box, knocked together so that the inside dimensions corresponded to the size and shape of the required false jaws, would be filled with a stiff paste of plaster-paris, and the pattern impressed in this paste in such manner as to centralize the part to be machined.

When the plaster had set, it would be taken out of the box and used as a pattern. After making the castings, all that was necessary was to machine the dovetails to fit the box chuck and to smooth them up a bit.

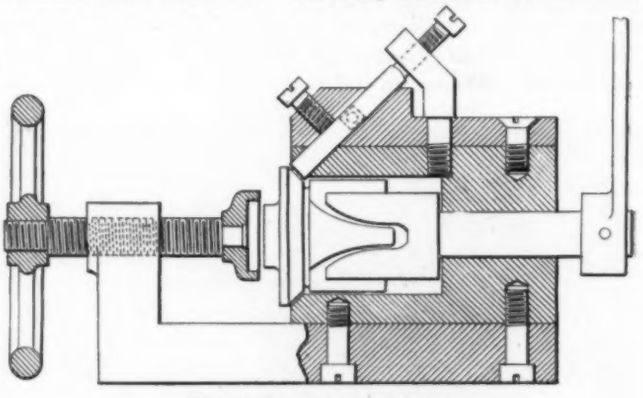
In making false jaws in this manner, but one plaster cast would be required if the job was symmetrical, otherwise it would be necessary to make two separate impressions. After a little practice in using this method, very good results were obtained, and many a job that would otherwise have shown a loss, turned over a profit.

Tool for Reseating Valves

By Mack Masters

The sketch herewith shows a tool that I have designed and made for the purpose of refinishing the faces of the large air valves used in Westinghouse compressors. The valves are difficult to hold for machining by any ordinary means, and hitherto when I have found them so badly fitted as to make it impracticable to grind them, I have thrown them in the scrap box.

The device is quite simple in construction, as a glance at the sketch will show. The body and toolholder I have shown as two pieces for the reason that I used a piece of steel tubing for the former, but it can as well be made in one piece. The feed screw must center the valve holder and it must be threaded right hand to carry the valve to the cutter.



Device to reface valves

The angle at which the cutter is placed corresponds to the angle desired upon the valve face. The corner of the tool should project just a little below the diameter of the wings so that there will be no interfering shoulder left.

I use two setscrews to hold the cutter firmly, and one behind it to set it out as it becomes necessary. The fork that turns the valve must engage the wings loosely when the valve is up tight against its seat in the body.

The swivel on the end of the feed screw must be quite free in order that it may adapt itself to the valve. It may be kept from coming off by countersinking it at the bottom of the recess and peening over the end of the screw slightly.

Though I have shown a crank handle with which to turn the valve, a handwheel makes a neater appearance and is easier to manipulate.

Chasers for Self-Opening and Adjustable Dieheads

Simplified practice recommendation

Table I—Simplified List of Sizes Recommended

American National Coarse-Thread Series				American National Fine-Thread Series			
Size	Threads per Inch	Size	Threads per Inch	Size	Threads per Inch	Size	Threads per Inch
*5	40	9/16	12	8	36	9/16	18
6	32	5/8	11	†10	32	5/8	18
8	32	11/16	10	12	28	11/16	16
**10	24	3/4	9	‡1/4	28	3/4	14
12	24	1	8	5/16	24	1	14
***1/4	20	1 1/8	7	3/8	24	1 1/8	12
7/16	18	1 1/4	7	7/16	20	1 1/4	12
3/8	16	1 1/2	6	1/2	20	1 1/2	12
7/16	14	1 3/4	5				
1/2	13	2	4 1/2				

*Identical with size 1/8—40. **This size should be used in place of size 7/16—24. ***This size should be used in place of size 14—20. †This size should be used in place of size 5/16—32. ‡This size should be used in place of size 14—28.

IN accordance with the unanimous action on December 4, 1925, of the general conference of representatives of manufacturers, distributors, and users of chasers for self-opening and adjustable dieheads, the United States Department of Commerce, through the Bureau of Standards, recommends that the simplified list of sizes and varieties be established as shown.

While self-opening dieheads have a diameter adjustment, all chasers not stamped as indicated in the following tables will be regarded as specials.

The American National coarse-thread series is the "U. S. Standard" threads, supplemented in the sizes below 1/4 in. by sizes taken from the standard established by the American Society of Mechanical Engineers. The fine-thread series is composed of standards that have been found necessary, and consists of sizes taken from the standards of the Society of Automotive Engineers, and the fine-thread series of the American Society of Mechanical Engineers.

Table II—Spark-Plug Threads

S.A.E. Standard Spark Plug Thread		Regular Bushing Thread for Spark Plugs	
Size	Thds. per In.	Size	Thds. per In.
7/8	18	13/16	24

Table III—Special Sizes (To be discouraged)

American National, or U. S. Form			
Size	Thds. per In.	Size	Thds. per In.
1/4	24	1/4	32
5/16	20	5/8	24
3/8	20	11/16	20
7/16	16	3/4	18
7/16	18	3/4	20
1/2	18	7/8	16
11/16	16	1	16
1 1/8	6	1	20
2	12		

The sizes in Table V can be used for special thin adjusting or clamping nuts, and in general machine design.

Table IV—Threads for Lighting Fixtures and Fittings

American National, or U. S. Form	
Size	Thds. per In.
1/4	27
5/16	27
3/8	27
7/16	27
1/2	27
9/16	27
5/8	27
3/4	27
7/8	27
1	27

Table V—Railway Sizes (American National, or U. S. Form)

Straight, and Taper of 3/4 Inch per Foot			
Size	Thds. per In.	Size	Thds. per In.
1/2	12	1	12
9/16	12	1 1/16	12
5/8	12	1 1/8	12
11/16	12	1 3/16	12
3/4	12	1 1/4	12
13/16	12	1 5/16	12
7/8	12	1 3/8	12
15/16	12	1 1/2	12
		1 3/4	12

Table VI—Railroad Sizes (V-Form)

Size	Thds. per In.	Size	Thds. per In.
1/2	12	1	12
9/16	12	1 1/16	12
5/8	12	1 1/8	12
11/16	12	1 3/16	12
3/4	12	1 1/4	12
13/16	12	1 5/16	12
7/8	12	1 3/8	12
15/16	12	1 1/2	12
		1 3/4	12

Straight and Taper of 3/4-inch per foot (Special sizes to be discouraged)

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Constant Slippage on a Disk Clutch

Q. I am considering the application of a multiple disk clutch or a single dry disk type in a mechanism which necessitates a constant clutch slippage. I am at present using the expanding-shoe, leather-faced type, but desire one that is more secure and durable. My aim is to transform power from a rotary movement to a linear pressure that can be varied by adjusting the clutch. Please tell me how to proceed with the clutch design.

A. The standard handbooks contain basic design data on clutches of the type that you are interested in, and with their help you should be able to proceed. It is entirely feasible to construct a disk clutch that will operate under the conditions you name. One, a power forcing press that we have in mind, uses this design successfully.

There are, however, so many reputable manufacturers of clutches who have been through all of the preliminary design stages that we advise you to consult them before starting any new work yourself. Doubtless, you will be able to locate several standard clutches that will exactly suit your purpose.

Heated Air for Oil Burners

Q. Please give us your opinion on the value of air preheaters for use in connection with oil burners and heat-treating furnaces.

A. Heated air delivered into the burners on any oil furnace will improve the operation of the burner. The question in choosing the heater is not so much one of expected performance after installation, as it is in the design and location of the heater itself to insure delivery of the heated air and the most economical operation of the arrangement.

A Steel Tank for Sulphuric Acid Storage

Q. We use sulphuric acid for pickling steel. The action on the steel is very rapid, and with a ten per cent solution warmed up we can remove the scale from a sheet in short order. And yet we are storing the concentrated acid before it is run into the pickling vats in the steel tank located underground. We are wondering what condition the tank is in. It has been in use for a little over two years, and we have no way of getting at it for inspection.

We might say that we are raising the acid as we need it by means of compressed air turned into the underground tank.

A. The rapidity with which sulphuric acid will attack steel depends on its temperature and degree of concentration. A hot, ten per cent solution will act rapidly, while a cold concentrated solution will work on the steel but very little.

It is important that the air you blow into the tank for delivering the acid be dry and that you take every precaution to prevent local dilution of the concentrated acid by letting moisture into or near the tank. If it has been installed properly, it will be coated on the outside with a layer of tar or pitch so moisture from the ground will not get at it.

For your information, there are tanks available which have been coated with lead and those which are lined with glass that has been fused to the steel expressly for service in connection with acid.

Technical Literature Up to Date

Q. We desire to obtain data on various shop operations in order to check up on the way we do our work in all departments and to keep ourselves up to date. We operate a machine shop doing miscellaneous work. Please advise us how to proceed, aside from making the most of our very valuable subscription to the American Machinist.

A. The standard handbooks contain useful information on standard machine shop practice, and the various publishers of technical books are constantly bringing out new works on all technical subjects. There is, however, another source of valuable information in every department of the metal-working industries that all too few companies, such as yours, make adequate use of.

This source is the trade literature of the manufacturers who furnish your machines, your mechanical equipment and your supplies. The literature is available as shown in the weekly advertisements in the *American Machinist.* It is necessarily kept strictly up to date and is thorough in its coverage of the subjects in question, with very few exceptions.

You can secure this literature and can classify it according to your needs. But remember this important fact: The literature changes as practice improves, and to realize lasting benefit you must keep in close touch with each source in order to secure the latest information as it becomes available.

Tool for Roll Finishing Piston Rods

Q. Please tell me how to construct the tool for roll-finishing piston rods, driving axle journals, and similar engine parts.

A. The tool consists of a roll made of a material that can be hardened and carried on rollers or ball bearings in a suitable holder. The holder is arranged so that it can be secured to the lathe carriage.

The roll itself should measure between 3 and 4 in. in diameter, should have approximately a 1-in. shaft and should be about 2 in. in width. It should be hardened and ground flat across its face. The work to be roll-finished must be turned practically to size with a fairly smooth cut, before the rolling operation is started.

Technical Abstracts

Local and General Lighting

It has been the experience of manufacturers that a general overhead lighting system is satisfactory for most purposes. There are some classes of work, however, which require exceptionally high levels of illumination, ranging from 40 to 150 foot-candles. In some instances the required levels of illumination may be so high that a straight, general lighting system would be uneconomical. A combination of general and local lighting is then needed.

Local lighting units should be mounted on an adjustable arm so the light can be directed upon the work. The units should be mounted to prevent the light from reaching the eyes of adjacent workers. The use of diffusing bulbs in local lighting units will soften the shadows. All lamps should be completely shaded by a reflector to avoid glare. Roy A. Palmer, in the *Electrical Record*, February, 1926, p. 127.

The Foreman's Responsibilities

The position of a foreman is one hard to fill, and not the easy berth which a great many think it to be. Many foremen wish they had never accepted the job, there is so much to do, and a turmoil of criticism and strife is ever present. Superintendents clamor for production, and men respond reluctantly to the increased demand. Where such a condition prevails, foremen become surly, violent, or taciturn, get an "I don't care, I have done my best" spirit. The outcome of such a condition will be careless and faulty work, neglected machinery, and ultimately the foreman will be removed. Perhaps it was not his fault entirely, but he is the first man.

My ideal foreman would be a man of mature years, who preferably has learned his craft in the same line of work, who is a master craftsman with a well governed temper, and has also the quality of human sympathy with the men under his charge. But the principal requirement should be love for his work. Given such a man, his influence will permeate the entire force, and his craftsmanship, demonstrated to his men, will invariably insure production of a high standard. Records of investigations show that a heavy burden of responsibility falls on the foreman. There should be greater appreciation of the good foreman and for the education of young men to take his place. Matthew Lund in *The Annals of the American Academy of Political Science*, Jan., 1926, p. 197.

Aluminum Paint

Although aluminum paint has been employed for many years, the great expansion in its use has come in the past two years. The aluminum powder used in the paint is made by the progressive stamping of thin aluminum foil into minute flakes. The small particles are then screened to various sizes. This powder is mixed with suitable vehicles, such as heavy linseed oil, spar varnish, lacquers, amyl acetate and other bases to form the paint.

Aluminum powder is furnished as polished or unpolished. The polished powder yields a highly reflecting and brilliant surface as a paint. The properties of the paint are great opacity, high reflectivity, corrosion-resistance, and ability for heat insulating. It is useful as an outside paint in oil refineries, gas holders, structural steel work, by-product coke plants and other purposes. The reflectivity of the paint for light may be as high as 70 per cent, that is, only 30 per cent of the light striking its surface is absorbed and the rest is reflected. Dr. R. J. Anderson, *The Metal Industry*, February, 1926, p. 65.

Gears Heat-Treated Electrically

Two new furnaces for the heat-treatment of gears have been installed in one of the Detroit plants of the General Motors Corporation. Both are of the continuous, automatic type, electrically operated, one being an annealing furnace and the other for hardening the gears after carbonizing.

The annealing furnace has four conveyor tracks in the heating chamber, two carrying work entering at one end and two carrying work in the opposite direction. The cold work entering at either end absorbs heat from the hot work coming out so that the former is preheated and the latter partially cooled.

The hardening furnace is a vertical pusher type and is used for ring gears. The gears are moved through the furnace in the form of a vertical stack. The mechanism consists of a slide under the hearth at the side of the furnace and a plunger which raises the gear into its position at the bottom of the stack. The raised gear is held in place by three ratchets. The plunger then returns for another gear. The annealing furnace requires two operators and the latter but one. — *The Iron Age*, Feb. 11, p. 401.

Fusion-Welded Seams

In the fusion welding of pressure vessels, the longitudinal seams should be of the double-V type, that is, welded from each side half way through the sheet. The girth and the head seams may be of the single-V type, that is, welded entirely through from the outside.

Double-V longitudinal welds should be reinforced at the center of the weld on each side of the plate by at least 25 per cent of the plate thickness. Double-V girth welds should be reinforced 10 per cent. Single-V girth welds should extend entirely through the plate and should be reinforced at the center of the weld by not over 20 per cent of the plate thickness.

The sheets should not be allowed to lap during welding. In material $\frac{1}{4}$ in. or less in thickness the longitudinal seams need not be beveled. In material less than $\frac{1}{4}$ in. thick, beveling the heads will be sufficient. The shell need not be beveled at the head seams, but one side of each girth seam should be beveled.

At no point should the sheet on one side of the joint be offset with the sheet on the other side of the joint in excess of one-quarter of the minimum thickness of the plates. S. W. Miller, in *Mechanical Engineering*, March, 1926, p. 221.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

Salesmen Who Know Get Orders

THE cost of selling is not all sales resistance or getting the signature on the dotted line. Much of it comes after the order is taken and is due to the waste in getting the order properly filled. And much of this waste is due to the ignorance of the sales force as well as to the mechanical features involved.

We recently questioned a friend as to his reason for buying supplies from a small concern instead of the largest one in the field. "Because," he said, "all the big concern salesmen know is how to take an order, and that the company's main office is in Podunk. If I want any information it has to come from Podunk after going through a dozen hands to get there. The manager of the branch office doesn't even know what the instruments I buy are used for. So I buy from a small concern with salesmen who know the job and where I can get information and service at first hand."

This may be one of the reasons that small concerns survive in the face of competition from much stronger competitors. There is evidently an excellent opportunity for waste elimination in branch offices.

Photographic Shop Records

CONTRACTORS of all sorts of construction work make it a practice to take photographs daily or weekly for a record of progress. A few machine building concerns follow a similar practice and find it profitable as a matter of record and as a guide in future work. One concern photographs unusually large or intricate castings as they come out of the sand to show how they were gated. This practice keeps an indisputable record and helps when the next unusual job comes along.

Machine builders would do well to adopt this practice both in the machining and erection of their product. Photographs of this kind have great value in recalling forgotten phases of work that has been done in the past, and that would be of value on new jobs. Possible customers are impressed by photographs of this kind, as it shows them how the shop handles work in progress. Progress photographs should be used to keep a record of operations and of the way in which a product is handled.

Helping Men Earn More Money by Time-Study

SKINNING a cat can be done in several ways according to the old adage. Likewise there are numerous ways of putting over new ideas.

Time-study has been opposed in many shops. Not because of objections to the studies themselves but rather because of the way in which the studies were used to lower piece prices. The too frequent plan was to time-study an exceptionally fast man and set all prices by his standard. Opposition was the natural result.

A much better method is in use in one of the large industries of the country. When a man is earning less than his fellows they make a time and motion study of him, to find out why. This enables them to show him how to earn as much as the average at least. No man objects to being time-studied when it helps him to earn more money. So the cat is skinned, not only without objection, but so as to enjoy the operation.

Trade Schools Under the Guild System

THE General Society of Mechanics and Tradesmen of the city of New York, which has recently completed its 140th year of service to the mechanic arts, deserves more than a word of commendation. Established in 1785 as an Americanized form of the old English Guild, it founded a free trade school in 1820, and the first free circulating library in the same year.

The arts and trades school of the Society had an enrollment of 3,200 for the year 1925. The objects of the school are for the free instruction of young working men in the mechanics', artisans', builders', and printers' trades. The majority of the students at present are enrolled in the drafting and designing courses. The free library of the Society now contains 92,725 books. It is unusual to find a society of this kind devoting all its major activities to free educational work among workmen, and its efforts are deserving of success.

Just Suppose

JUST suppose that management were really in earnest about its personnel problems. That in addition to saying that personnel matters are as important as production and distribution, it gave equal time to them.

Can't be done, you say? Would cost too much? Production and distribution would suffer? Well, the success of some companies that have extensive personnel programs would hardly bear out those objections.

Shop Equipment News

W. F. & John Barnes Co. Production Gang Drill, 20-Inch

A six-spindle, 20-in. gang production drilling machine has been placed on the market by the W. F. & John Barnes Co., Rockford, Ill. The machine is composed of units similar in design to the single-spindle machine described on page 558, Vol. 61, of the *American Machinist*. The machine is intended for production drilling, reaming, tapping, boring, counterboring, spot facing or other combinations of operations. In Fig. 1 is shown a front view of the machine. Fig. 2 shows the arrangement of the motor drive at the rear. Each spindle is equipped with a Johnson friction clutch and is driven through a Morse silent chain. The guard for one of the spindle-driving chains has been removed, and also the upper half of the motor-drive chain guard has been removed to show the arrangement.

Eight mechanical changes of spindle speeds are available, ranging from 72 to 500 r.p.m. The feed changes number twenty-four and range from 0.010 to 0.231 in. per rev. of the spindle. Eight of the feed changes are provided with the machine, and special pick-off gears can be furnished to give any of the twenty-four feeds needed to meet the requirements of the work to be done.

The main drive is contained in the column of the machine and consists of heat-treated alloy steel gears mounted on multiple-spline shafts that run in bronze bearings. The column forms an oil-tight compartment so that the driving mechanism can be well lubricated. The spindle is driven through a pair of bevel gears from the main gear train, the spindle driving gears being located directly above the main bearing. Four splines transmit the power of the driving gear to the spindle so that the troubles due to loose keys are eliminated. Means are provided by which the spindle driving pinion and gear can be kept in proper adjustment.

From the top shaft in the speed transmission power is transmitted to the feed mechanism by means of a heat-treated alloy steel helical gear meshing with a bronze gear. A pair of sliding gears is housed in the column at the right-hand side of the head. These gears are shifted by means of a lever.

From the pick-off gears a shaft carries the power to the feed worm and wormwheel at the right-hand side of the column. A spirally grooved disk attached to the cross shaft carries a stop that may be set to trip the feed automatically at any desired point. A heavy spiral spring is employed to counterbalance the spindle, and it can be set to automatically return the spindle to the starting point after the feed has been disengaged. The table is supported by means of three screws,

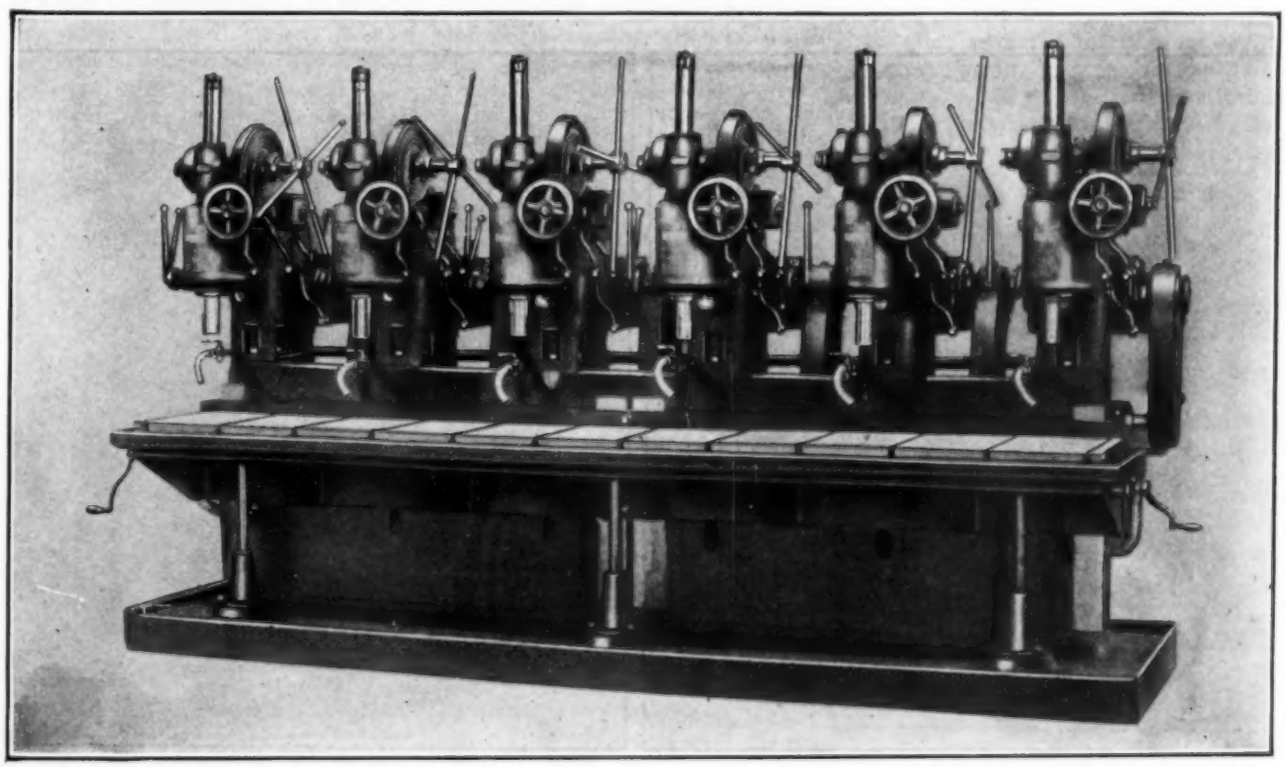


Fig. 1—W. F. & John Barnes Co. Production Gang Drill, 20-Inch

Shop Equipment News

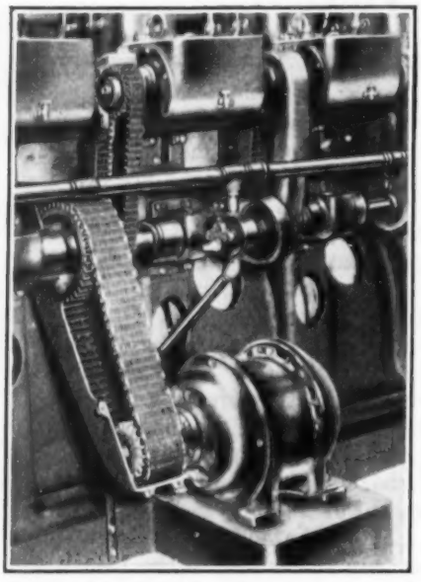


Fig. 2—Rear view showing Morse silent chain drive

as shown in Fig. 1. They are rotated by means of a long horizontal screw with handles at both ends.

A coolant reservoir is located in the base of the column, and a suitable pump and piping are provided to distribute the liquid on the tool and the work. The machine has sufficient capacity to drive a 1½-in. high-speed drill in steel.

Anderson Drilling and Tapping Machine, Ten-Spindle

The ten-spindle drilling and tapping machine shown in Figs. 1 and 2 is manufactured by the Anderson Die Machine Co., Bridgeport, Conn., for tapping ten holes in one piece at one passing through the machine. Fig. 1 is a view of the operator's position.

Two single dial, multiple-spindle, tapping units, one of which was previously described on page 155, Vol. 56, of the *American Machinist*, have been combined on a single base to make up the ten-spindle machine. It is possible to use one of the units for drilling, countersinking or counterboring holes and the other for the tapping operations.

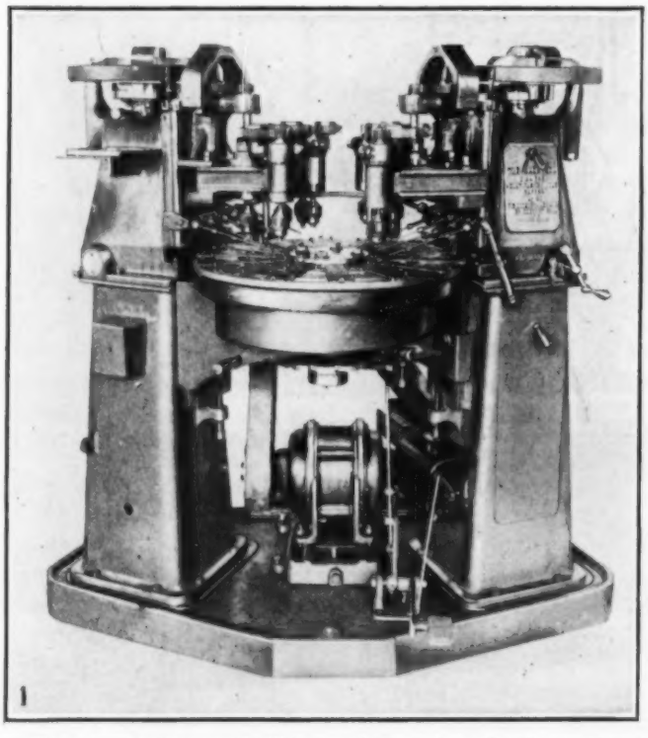
The two units are positively timed with the indexing of the dial by means of a shaft at the rear of the machine, as shown in Fig. 2. This shaft is driven through belting by means of an individual motor. The speed of the machine is controlled by means of pulleys of different diameters mounted on the shaft. The gear guards have been removed so that both photographs can show the operating mechanisms of the machine.

The spindles are reversed by means of a toothed segment and train of gears instead of by means of a clutch. The segment is controlled by means of a crankdisk at the upper end of a vertical shaft extending through the central part of the main frame. To this vertical shaft are secured the cams for indexing the dial and for locking it in its proper position.

The dial used on the machine is similar in its method of operation to the dial-feeding arrangements commonly used on small punch presses. The ratchet which controls the dial is supplied with the same number of teeth as there are openings in the dial for accommodating the pieces to be tapped.

The spindles are adjustable so that any combination of ten holes can be had. The dials are made with adjustable openings to suit the arrangement of the spindles. Ball bearings are used on the high-speed shaft.

The machine is designed to run at a speed of 1,200 strokes per hour, so



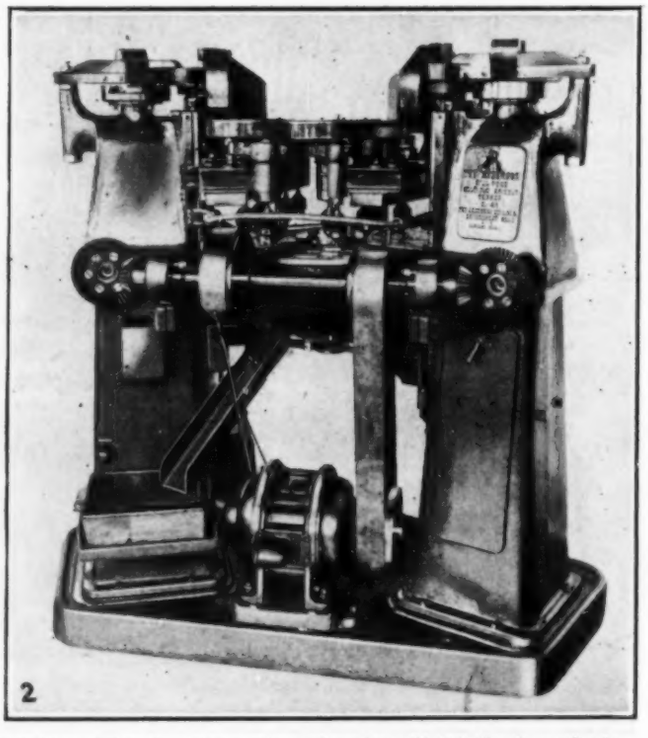


Fig. 1—Anderson Drilling and Tapping Machine, Ten-Spindle. Fig. 2—Rear view showing dial indexing shaft

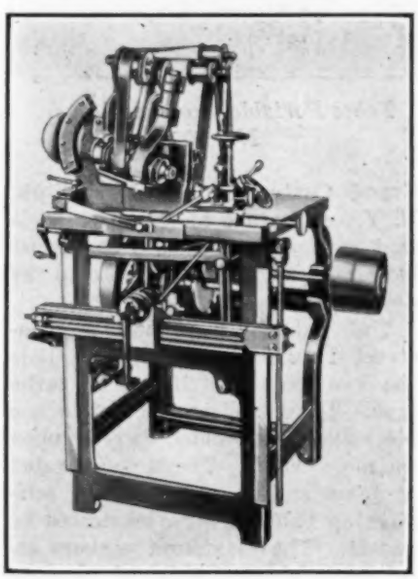
Shop Equipment News

that in this time it will handle 12,000 holes. The machine can be used to advantage in tapping nuts and small pieces containing a number of holes to be tapped. The form of drive employed permits of timing the various movements accurately without danger of having the timing upset.

Hooker Ball Bearing Band and Circular-Saw Sharpener Automatic, No. 1

The No. 1 automatic ball bearing band and circular-saw sharpener illustrated has been placed on the market by the Hooker Manufacturing Corporation, St. Johnsbury, Vt. The illustration shows a belt-driven model, but the machine is also equipped with individual motor drive. The machine will accommodate saws of various gages, diameters and ranges, but cannot be used for sharpening novelty saws or saws with specially shaped teeth. The grinding wheel oscillates to give any desired bevel to cut-off saws.

A cam-action control is used on the machine to produce various shapes of teeth. The same cam can be used for sharpening cut-off and rip saws. An adjustment is also provided to accommodate all tooth spacings within the range of the machine. The machine is equipped with a feed mechanism supported by means of a rigid frame to insure accuracy. The feed mechanism operates to place each tooth for grinding at the same point in its travel past the grinding wheel. The feed finger is made from high-speed steel and it is knife-edged to engage the face of the tooth at any desired point. A feed-finger screw changes the front of the tooth to the back face of the grinding wheel without changing the spacing. The proper spacing for fine- and course-tooth saws is secured by means of a spacer screw.



Hooker Ball Bearing Band and Circular-Saw Sharpener, Automatic, No. 1

The frame of the machine is bolted and is held together by means of heavy cross girts to secure rigidity. The arbors are mounted in dust-proof ball bearings. The arbor bearings of the grinding head are large and the sliding ways are broad and adjustable to take up wear. The machine is lubricated by means of the Alemite system. The band saw rest is provided with a roller for carrying the saw. It can be easily replaced and is adjustable to bring the saw to the proper height. The arbor is driven direct by means of a large belt running from the countershaft of the machine over self-adjusting idlers with spring control. The grinding wheel is adjusted to its proper height by means of a conveniently located handwheel.

The controls for the machine are directly in front and are said to be placed within easy reach of the operator. A start-and-stop lever is provided in order to permit stopping the feeds of the saw and the travel of the grinding wheel without shutting off the power. A timer handwheel conveniently located is used to change the shape of the tooth of the saw as desired.

The grinding wheel furnished with the machine as standard is 8 in. in diam. and has an arbor hole ¾ in. in diam. The tight and loose pulleys are 7½ in. in diam. and have a face 2½ in. wide. They rotate at 300 r.p.m. A ½-hp. motor is used for the direct drive. The machine is equipped with dust guards and with gear guards on the motor-driven model. The height of the machine is 54 in. and the floor space required is 36x37 in. The weight of the belt-driven model is 725 lb., and that of the motor-driven machine is 750 pounds.

Olsen Direct Motor-Driven, Hydraulic, Brinell Hardness-Testing Machines, Production Type, Nos. 1 and 2

Two sizes of production-type direct motor-driven, hydraulic Brinell hardness-testing machines, one of which is illustrated, have been placed on the market by the Tinius Olsen Testing Machine Co., 500 North 12th St., Philadelphia, Pa. The Brinell load of 3,000 kg. is applied and removed by means of a small knurled knob which can be seen on the right-hand side of the machine.

The pressure can be maintained momentarily or as long as desired, according to specification. The load is controlled automatically, so that underloading or overloading will be prevented, and adjustment is provided for calibration. The hydraulic pressure is exerted on the main plunger without recourse to packing.

In operation, the specimen is clamped by means of the handwheel, and then the pressure is applied and removed quickly. The gage shown indicates the progress of the test. Olsen illuminated microscopes are supplied with the machine as regular equipment, in order to facilitate obtaining the Brinell hardness numbers. When desired, the machines can be equipped with Olsen direct-

Olsen Direct Motor-Driven, Hydraulic, Brinell Hardness-Testing Machine, Production Type

Shop Equipment News

reading floating-type, depth-measuring instruments.

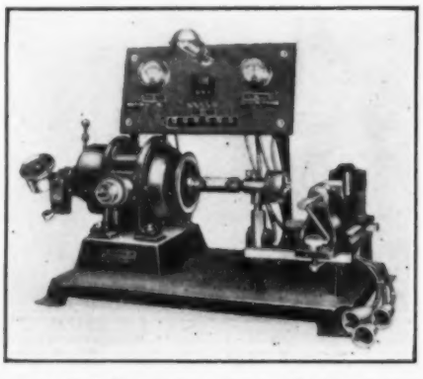
The machine is self-contained and is supplied with a fractional-horsepower motor to suit the requirements. The No. 1 machine has a gap of 4 in. and is suitable for parts up to 7 in. in diam. The height of the machine is 30 in., the width is 18 in., and its length is 24 in. The weight of this size is 300 lb. The No. 2 machine has a gap of 7½ in. and will accommodate parts up to 15 in. in diam. Its height is 42 in., the width is 20 in. and its length is 30 in. The weight of the No. 2 testing machine is 600 pounds.

Weidenhoff Electric Test Bench, Model 36

The model 36 electrical test bench shown in the accompanying illustration is being manufactured by Joseph Weidenhoff, 4352-58 West Roosevelt Road, Chicago, Ill.

The motor supplied with the unit is a variable speed one and can be operated at up to 3,600 r.p.m. in either direction. It is manufactured by the General Electric Co. At 1,800 r.p.m. it develops 1¼ hp. The tachometer, which is directly connected to the motor shaft, is calibrated for from 400 to 4,000 revolutions per minute.

The ignition breaker for the unit consists of a cam attached to the motor shaft, and a standard breaker plate with tungsten contacts for testing coils and condensers. A condenser included with the set can be plugged in or out of the circuit. The rotary spark gap has a dial calibrated in 360 deg. and indicates the action of distributors and coils when they are being tested on the bench.



Weidenhoff Electrical Test Bench, Model 36

The generator vise has three-point suspension to automatically center round-type generators with the driving chuck. Square-type generators and magnetos are supported on an adjustable bracket. The vise is of a sufficient size to handle large generators. Distributors are held in the vise and driven by means of a clamping chuck on a nut at the end of the shaft.

The flexible coupling is designed to have no protruding parts. It will allow a misalignment of 1¼ in. in the shaft length. It can be easily disassembled and reassembled. Wick oiling is used. The diameter is 2 in. and the overall length of the coupling is 4 inches.

The slate panel is 21x9 in. in size. It is usually supplied with a voltmeter calibrated for 0-25 volts, with ammeters calibrated 30-0-30 and 300-0-300, with a cutout for 6 and 12 volts and with a lamp for ground tests and illumination.

The bench is 32½ in. long, 20 in. wide, and 24 in. high. It weighs 220 pounds.

"Elkonite" Copper-Tungsten Electrode

The Elkon Works, Inc., of P. R. Mallory & Co., Weehawken, N. J., are manufacturing and marketing "Elkonite" copper-tungsten electrodes developed by the General Electric Co. They are intended especially for use in resistance or spot welding operations.

The copper-tungsten alloy electrode is intended to make unnecessary the frequent redressing or changing of electrodes in manufacturing welding where the hard copper electrode is ordinarily used and where it tends to become annealed under the heat of the welding operation.

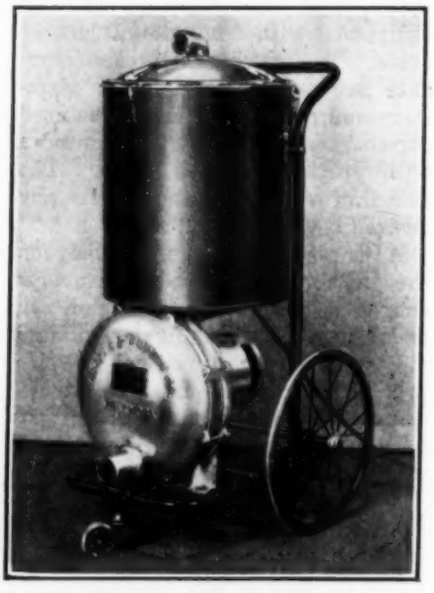
The alloy used in "Elkonite" electrodes has a Brinell hardness of 225 where ordinary hard copper has a hardness of 82. Its compressive strength is 208,000 lb. per sq.in. The tensile strength is 56,350 lb. per sq.in. It is claimed that the material will not anneal at red heat.

The first cost of the alloy is higher than that of copper, so that its chief value at present is in use under conditions where copper will not stand up, such as hot-upsetting rivets electrically, in facings for clamps for rod welding, split dies for welding steel spokes to both the rims and hubs of steel wheels and similar processes.

In welding, copper-tungsten inserts are used, and the remainder of the die is of copper. Oversized pieces of the alloy are forced in a hole in the die, or the die can be cast around them. Tests are said to have shown that over 1,000 welds can be made with the die still in good condition.

"Tabco" Portable Vacuum Cleaner, No. 500

The "Tabco" portable semi-heavy-duty vacuum cleaner shown in the illustration, has been designed by the Allen & Billmyre Co., Inc., 512



Tabco Portable Vacuum Cleaner, No. 500

Grand Central Palace, New York, N. Y. A feature of the machine is that it may be used also as a dust blower by attaching the hose to the discharge pipe.

The exhauster proper is constructed entirely of aluminum. It is the two-stage centrifugal or turbo type. The impellers are cast in one piece and are mounted directly upon the motor shaft. The motor is rated at ½ hp. and is equipped with self-aligning ball bearings, lubricated by grease. The maximum vacuum attained is about 2.5 in. of mercury and the volume is 75 cu.ft. per minute.

The exhauster unit and a dust collecting tank are carried in a tubular-

Shop Equipment News

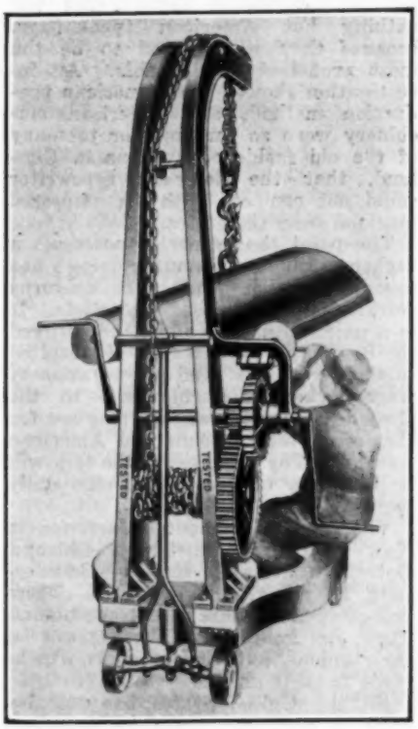
steel frame which in turn is supported on two large rubber-tired rear wheels and a small front caster wheel. The large wheels allow the machine to be easily transported up and down stairs.

Standard equipment includes 15 ft. of wire-reinforced flexible hose, 1¼ in. in diam. and 25 ft. of molded rubber-covered wire with the necessary connections. The motor may be run on either d.c. or a.c., single-phase current, and at 110 or 220 volts. The net weight is 105 lb. without tools or hose. The extreme height is 44. in., width 22½ in., and length 27 inches.

This vacuum cleaner has been designed for use in office buildings, factories, hotels, institutions and other places where people congregate in numbers.

Canton Safety Friction Load Brake for Cranes

A safety load brake for cranes is being manufactured by the Canton Foundry & Machine Co., Canton, Ohio. The illustration shows the device applied to a Canton improved portable crane similar to the one previously described on page 611, Vol. 47, of the *American Machinist.*



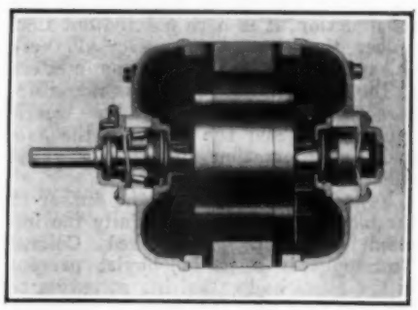
Canton Safety Friction Load Brake for Cranes

By means of the load brake the load is held at any point and it is necessary to wind the load down as well as to raise it. The brake consists of friction disks in connection with a helix. It is so designed that it can readily be applied to any of the usual types of portable cranes.

Howell Automatic "Rotor Re-Centering" Motors

In order to insure a uniform air gap at all times in motors, the Howell Electric Motors Co., Howell, Michigan, has introduced a complete line of motors equipped with anti-friction bearings that are used in conjunction with a device to keep the rotor automatically centered.

The bearings are standard Timken tapered roller bearings. The inner race is fitted on the shaft with a light press fit and the outer race slips into the housing of the motor end bell with a sucking fit which allows creeping to take place. Behind the outer race is placed a fluted



Howell Automatic "Rotor Re-Centering" Motor

wire spring, which is held in compression by the end cover. Thus a continuous thrust is placed upon the bearing.

The manufacturers claim that this spring automatically takes up any wear that may take place in the bearings, since the bearings are tight at all times; that the spring permits lateral expansion of the shaft due to heat without setting up a high internal thrust; that the bearings run more quietly; and that the rotor is centered at all times.

The bearings are arranged for grease lubrication and protection against the intrusion of dirt and loss of the lubricant is assured by labyrinth seals.

Keuffel & Esser "Normograph"

A device consisting of a metal guide and a series of transparent xylonite lettering templates has been introduced by the Keuffel & Esser Co., 127 Fulton St., New York, N. Y., to facilitate neat lettering of engineering and architectural drawings, signs, cards and so on.

The metal guide is held against the working edge of a T-square or other straight edge with the body of

Use of the Keuffel & Esser "Normograph"

the guide resting on the upper face of the straight edge. The jaw of the guide projects over the edge and holds the zylonite template far enough above the surface being lettered to avoid all danger of smearing.

The "Normograph" stencil has a system of perforations which are so formed that when the point of a special pen is moved in contact with the edges either whole or part of the letters of the alphabet and of numerals are formed. The stencils have been designed so that there are as few openings as possible consistent with rapid lettering. Many of the characters can be drawn with a single opening; in no case will more than two openings be required, nor will any retouching or filling in be necessary later. Twelve different pairs of stencils, capitals and lower case, may be obtained in various styles and sizes of letters, either vertical or slanting.

The "Normograph" pen is shaped like a funnel and consequently has considerable ink capacity. The neck of the funnel is the pen point and is non-clogging. The pen can be inserted in an ordinary penholder, or a special holder used.

News of the Week

Hearings on Metric Legislation Draw Arguments from Opponents of Bill

Railroads and War Department give testimony

Arguments against metric system legislation by representatives of the railroads apparently made a deep impression on most of the members of the House Committee on Coinage, Weights and Measures. When the hearings opened several members of the committee had only a superficial knowledge of the question. During the testimony of the proponents of the bill it looked as though a favorable report from the committee would be forthcoming. These new members of the committee soon learned there is another side to the question.

The evidence submitted by the railroad witnesses seems to have swung the balance the other way. The further testimony which will be taken March 18 and 19 is expected to crystallize the feeling against the measure to the extent necessary to insure the pigeon-holing of the bill. One member of the committee suggests that perhaps the best way to kill the idea of prescribing by law what weights and measures are to be used would be to report the bill favorably. This would have the effect of precipitating the opinion against it. As it is, many of those opposed to such legislation are taking it for granted that there is no chance for its adoption.

John L. Leighty, of the engineering staff of the Southern Railway, presented data to the committee to show how great the cost of the change would be. A part of that cost was estimated as follows:

Additional Investment Cost:	
Changing mile posts	$ 1,835,000
Changing tariffs	100,000,000
Changing standard plans	15,000,000
Change in shop machinery, tools, etc., and additional stock of supplies	216,000,000
	$332,835,000
Additional Annual Cost:	
Maintenance of property	$60,000,000
6% on additional investment	19,970,000
	$79,970,000

Alfred P. Thom, general solicitor of the Association of Railway Executives, testified in opposition to the bill on behalf of his organization and also for the American Railway Express Company.

J. V. Neubert, an engineer representing the New York Central Lines; W. P. Wiltsee, chief engineer of the Norfolk & Western, and James E. Howard, presenting the machine shop point of view, also testified in opposition to the measure.

Colonel W. H. Tschappat, of the General Staff of the Army, presented the following from the Chief of Staff:

"It is believed that the enactment of this bill at any time would increase the difficulties of the War Department connected with mobilization and procurement of supplies for a period of many years after the provisions of the bill were in effect. It is considered that the difficulties of changing from the present established system of weights and measures to the new system would be almost impossible to overcome, even though the new system were applicable to the limited extent stated in bill.

"While it was undoubtedly the purpose of the bill as drawn to avoid the tremendous undertaking of changing to the metric system in manufacture and construction, it is here pointed out that unless the change is universal there will necessarily be two systems in effect at the same time—one in the manufacture of articles, that being the American system, and the other in the sale and transportation of articles, that being the metric system."

Representative Britten, the author of the bill, did not take gracefully the implied criticism. He asked Colonel Tschappat if a paid lobbyist present in the room had called his attention to the fact that hearings were in progress. Colonel Tschappat did not answer the question but stated that he had been instructed by the Chief of Staff to appear and that he was authorized to represent the War Department.

It also was learned that Secretary Hoover had told the committee informally that he did not favor the bill.

Foreign Trade Council Wins Tax Fight

The culmination of a long and persistent effort on the part of the National Foreign Trade Council to relieve the income tax burden on American residents in foreign countries is the new provision in the Revenue Act of 1926. Section 213 of this Act, which defines "gross income," reads in part as follows:

"In the case of an individual citizen of the United States, a bona fide nonresident of the United States for more than six months during the taxable year, amounts received from sources without the United States if such amounts constitute earned income as defined in section 209; but such individual shall not be allowed as a deduction from his gross income any deductions properly allocable to or chargeable against amounts excluded from gross income under this paragraph."

Section 209 states that the term "earned income" means wages, salaries, professional fees, and other amounts received as compensation for personal services actually rendered, but does not include that part of the compensation derived by the taxpayer for personal services rendered by him to a corporation which represents a distribution of earnings or profits rather than a reasonable allowance as compensation for the personal services actually rendered.

British Machinists Here to Study American Shop Methods

The announcement that appeared in the daily press last week to the effect that a delegation of British machinists and factory superintendents had arrived for a visit in the United States in search of technical knowledge of our production methods has caused no little comment in the machine tool and machinery trades.

The decision is said to have been made following the discovery that the British government departments use nothing but American typewriters, because they were found to be the most proficient and durable. An investigation showed that American production methods and American machinery were so far superior to many of the old fashioned systems in England, that the domestic typewriter could not compete with the imported machine from the states.

The point that America possesses a higher skill in manufacturing has touched British pride. It concerns workingmen as well as capitalists. It is a national matter and it has stirred the British people to action. It resulted in the decision to send a delegation of wage-workers — machinists — to the United States, so that they may see for themselves the superiority of American methods. The expenses of the trip will be borne by one of the London daily papers.

Visits will be made to factories in New York, Philadelphia, Chicago, Detroit, Cleveland, Buffalo, Schenectady, Pittsburgh and Baltimore. These delegates are members of trade unions. They are going with the consent of their unions, and their reports will be made to their unions.

So, the United States has now become a sort of "promised land" to British wage-workers and manufacturers.

Machinery Exhibit at Railway Meeting

Railroad engineers and mechanics will have their opportunity to learn of the latest developments in their industry at the annual meeting and exhibition of the American Railway Association, Mechanical Division, which will be held at Atlantic City, June 9 to 16. This division includes the master car builders and the master mechanics, besides a number of the higher executives of the repair and construction departments of the railroads.

A good part of the sessions will be devoted to hearing and analyzing the reports of committees investigating car matters, locomotives and general construction topics. The exhibit will include many interesting innovations. Invitations have been extended to manufacturers of and dealers in all kinds of railway supplies. The show will be staged on Young's Million Dollar Pier and in the new building adjacent thereto. Division VI of the American Railway Association, which is the department of Purchases and Stores, will meet on the pier at the same time. A special building to be called "Machinery Hall," has been set aside for the exhibit of machine tools. J. D. Conway, located at the association's main office in Pittsburgh, is in charge of the exhibit.

Railway Supply Men to Exhibit

The first event of the spring convention period that is of particular interest to railroad executives is the annual convention and exhibit of the International Railway Supply Men's Association in conjunction with the International Railway Fuel Association. This meeting will be held in the Hotel Sherman, Chicago, May 11, 12, 13 and 14. The meetings will cover subjects of interest to railroad supply men and the exhibit will interest those who are charged with the purchase and maintenance of engine, shop and other mechanical appliances. Earl M. Thulin, 715 Peoples Gas Bldg., Chicago, is assistant secretary of the association and in charge of the convention.

International Congress for Foundrymen

The American Foundrymen's Association has announced the program for the technical sessions of the second international Foundrymen's Congress to be held at Detroit, Sept. 27 to Oct. 1. Foundrymen from every branch of the industry—steel, cast iron, malleable iron and non-ferrous—will be interested in the various topics selected for discussion. The sessions will cover all phases of foundry practice, metallurgical, shop and general management.

A few of the major subjects to be discussed are: Foundry costs, refractory problems, sand control in the foundry, permanent and long-life molds, apprentice training, materials handling and management.

In addition to the above, for the steel foundrymen there is scheduled a session on steel foundry shop problems, and a session on steel metallurgy. John Howe Hall, R. A. Bull, Bradley Stoughton and other prominent steel foundry experts have been secured to address these gatherings.

For the gray iron foundrymen there will be two special sessions pertaining to specific metallurgical and shop problems of the cast iron industry.

The non-ferrous sessions will be joint meetings of the A. F. A. and the Institute of Metals Division of the A. I. M. E. These special sessions will be symposiums on temperature control, and casting nickel alloys; a luncheon round table discussion on brass foundry problems and a session on casting aluminum and aluminum alloys.

For the malleable foundrymen, in addition to the usual session on technical problems, there will be held a luncheon round table discussion on practical shop problems.

Oil Burner Association to Meet in Detroit

With a program of addresses and papers from authorities on oil burning problems, the third annual convention of the American Oil Burner Association will be held at the Book-Cadillac Hotel, Detroit, April 6, 7 and 8. At the same time there will be an exhibit of oil burning machinery and apparatus, at which several hundred manufacturers are expected to be represented. Both domestic and industrial burner manufacturers, dealers and distributors, architects, engineers, service men and executives are expected to attend the meetings and the exhibit.

An attractive list of speakers has been arranged by the committee in charge of the conventions and practically every phase of this growing topic will be taken up and discussed at length. Leon D. Becker, executive secretary of the association, is in immediate charge of the program.

S.A.E. Meeting to Follow Big Race

Thousands of automobile race fans and engineers will go to Indiana from all parts of the country at the end of May to attend the annual Memorial Day 500-mile race on the Indianapolis speedway and then move on to the four-day semi-annual meeting of the Society of Automotive Engineers, which is to be held at French Lick Springs from June 1 to 4.

The meetings committee of the society is preparing an attractive program of engineering topics for discussion and of sports events to be held on the golf courses, tennis courts and baseball field. It is intimated that a number of very stimulating, if not even sensational, revelations will be made at the technical sessions. Many unique exhibitions and demonstrations will be made. Roads leading to the Springs from all directions are reported excellent under all weather conditions, hence a large number of members and their guests are expected to drive to the meeting.

Plans for Meeting of Welding Society

Definite plans have just been announced for the annual meeting of the American Welding Society, which will be held in the Engineering Societies Building, West 39th Street, New York City, April 21, 22 and 23. The program includes papers and discussions on many important present-day welding problems, with prominent speakers as leaders.

There will be a review of the progress made by the various sub-committees appointed by the association, including those on materials for welding, high-temperature welds, and training of operators. Among the subjects to be covered by separate sessions are: Gas welding, electric welding, education, welding in the automobile industry, design in piping installation, tanks, and containers, and structural steel work. There will be the customary luncheons, a dinner dance and an inspection visit to the plant of the Metal and Thermit Corporation.

National Tractor Meeting Postponed

The national tractor meeting, which was scheduled to be held in Chicago on March 25 and 26 under the joint auspices of the American Society of Agricultural Engineers and the Society of Automotive Engineers, has been postponed by agreement of the two societies. After a careful canvass of the situation, it was decided that autumn will be a more suitable time for the meeting than early spring, and the dates for a fall meeting are to be announced later.

London Mechanical Engineers Elect

William Reavell has been elected president of the London Institution of Mechanical Engineers. He founded the firm of Reavell & Co., Ltd., Ipswich, manufacturers of air compressors, etc., in 1898. Prof. W. E. Dolby and Sir Henry Fowler have been elected vice-presidents.

The new members of the council are: H. I. Brackenbury, Prof. G. F. Charnock, Lieut.-Col. E. Kitson Clark, Eng. Vice-Admiral R. B. Dixon, A. L. Evans, F. H. Livens and Sir E. Petter.

John Fritz Medal to Edward Dean Adams

Presentation of the John Fritz gold medal to Edward Dean Adams will take place in the Engineering Societies Bldg., New York City, on the evening of March 30. A program of speaking has been arranged, with Dr. Frank B. Jewett presiding, and James M. Beck and Professor Arthur E. Kennelly collaborating.

The award is made to Mr. Adams by a committee representing civil, mining, mechanical and electrical engineers for his "vision, courage and industry in making possible at Niagara Falls the birth of hydro-electric power."

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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THERE is a feeling that business has been helped rather than hindered by the recent decline in the stock market. The basis of this feeling is somewhat obscure, but it is very important, nevertheless, for prosperity and hard times are chiefly due to the state of the public mind in a good many cases.

It may be in order to add that the optimism now dominant among American business men is largely a reflection of the supreme confidence in the wealth of the United States and the fact that everyone who wants to work can earn a good living. In some directions wages are being increased, and it is estimated that the advance granted to New York mechanics and helpers in the building trade last week means an annual increase of about $50,000,000 a year in the cost of construction in New York. It is therefore worth noting that a slight decrease in building permits granted in 440 cities during February is reported, and that the treasurer of the New York Hotel Men's Association has issued a statement warning lenders and building operators that New York has more hotels than it needs at present and that an increase in their number would be highly dangerous.

The decline in the value of some of the Federal and Joint Stock Land bank shares is another feature of the situation that is a little at variance with the prevailing optimism. It has provoked a good deal of comment, although it is only fair to say that it seems to be due to excessive caution on the part of the Federal Land Bank Board at Washington.

But the outlook otherwise is remarkably serene, and even the stock market is recovering from the blow recently dealt it with remarkable promptitude. Opinions differ as to whether the Van Sweringens will reattempt the Nickel Plate merger along lines that will be more satisfactory to the Interstate Commerce Commission, but confidence in the ultimate consolidation of the American railways into a few systems is undisturbed, because it is generally recognized that it is economically essential.

Of the commodity markets there is not much to say. Most of them have been relatively steady. There seems to be a natural corner in tenderable cotton, and the expectation of any important decline in the value of such cotton for the balance of this season has been abandoned. Low grades are at the irreducible minimum, and the future of prices depends largely upon the outlook for the new crop, which is at present so good that the law of average suggests a change.

Wheat and corn have fluctuated within narrow limits. Farm reserves, though small, were somewhat larger than had been expected. Sugar has yielded under the competitive selling of the Porto Rico crop, but the foreign demand is heavy, and at the equivalent of 2¼ cents for Cuban raws landed New York the offtake has been large. The coffee market, though steady, seems to reflect some nervousness lest the Brazilian government may not be able to finance the large stocks now held and a possible increased crop next season. But the facts are hard to obtain as they are effectively camouflaged.

The dry goods trade is in the main satisfactory, but hand to mouth buying has been resumed and stocks are not being accumulated. Raw wool is a shade lower. So is silk. Rubber advanced about five cents a pound on the New York Rubber Exchange, but public interest in the commodity is not great, and the fluctuations have excited no comment. A better demand for steel is reported, although the unfilled orders of the U. S. Steel Corporation were smaller than expected.

The money market is perhaps a shade easier on the prediction that Canada will send $50,000,000 gold to the United States. The Federal Reserve statement shows an increase of $35,000,000 in the gold held and a reserve ratio of 74.6 against 73.2 per cent for the previous week. The U. S. Treasury has offered and sold $500,000,000 30-year bonds on a basis to yield 3.73 per cent.

In Washington the farmers' predicament continues to be the chief concern of many Congressmen and Senators. It was the pretext for passing a bill that may or may not relieve the government of Muscle Shoals, and some new scheme for fixing the prices of agricultural products or stabilizing them is brought out almost every day. A louder demand for a reduction in the tariff is also to be heard among those who claim to represent the agricultural interests of the country. Its sincerity is doubted in some quarters, but it is vociferous and the action of the Senate in demanding an investigation of the Tariff Commission is a straw which shows the surface drift of the current.

A substantial increase in our imports of steel, and the dwindling balance of trade in favor of this country are being emphasized, and in its latest bulletin the U. S. Department of Agriculture predicts that "the demand for most of the products of our farmers in 1926 will be no better than in 1925 if as good, unless the products of foreign countries should be reduced by an unfavorable season."

The news from abroad is interesting, but not specially important in its bearing upon the business situation in the United States. Early in the week Briand resigned the premiership of France, and a few days later was induced to put himself at the head of a new ministry. Those who know France best seem to think she is heading for some sort of a dictatorship a la Mussolini. The uncertainty has depressed the price of francs, but it is really surprising that they have not declined more.

What's Doing in Industry

The first half of March has brought about a favorable change in the machine tool and machinery market. From practically every industrial center comes the report of increased sales and more inquiries. The Mid-West again forges into prominence with automobile manufacturing centers leading in taking up new shop equipment.

Orders continue to come in to Detroit dealers, shops are busy and employment in industrial plants has broken another record. Chicago reports business on a par with February, with good demand for special machinery. Conditions continue to improve in Cincinnati, industrials showing a tendency to buy.

The New England territory reports business good for many types of special machines and industrial activity has increased more than 25 per cent over last month. New York dealers are more optimistic than they were last week, the market having taken on a better tone. Philadelphia business has increased in volume and the outlook is bright in that section. The South looks forward to an active building and industrial program this spring and already preparations are being made by the purchase of shop equipment to take care of expected business.

Recent figures released by the Department of Commerce show that exports of machinery in January were nearly half a million dollars more in value than they were last year. Internal grinding machines, pneumatic tools and small tools showed the greatest increase.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Cincinnati

Conditions have improved in the Cincinnati machine tool trade through the past week, according to statements of manufacturers and selling agents. A greater number of orders were booked than in the previous week, and inquiries were more numerous.

The feature of the week was a substantial increase in sales to concerns in the automotive industries, and there also was an increase in the number of inquiries coming from this source. No buying by the railroads is reported, but they continue to send in many inquiries.

There was a fair volume of buying by industrial users of machine tools and considerable buying was done by the electrical industries. Several sales to concerns in the hardware industry also are reported.

The business outlook is regarded as favorable. It is thought that the vast amount of construction work here, including everything from bungalows to skyscrapers, will soon have a favorable influence on the machine tool market, through increasing the demand from industrial users. While building is not a direct influence, it is pointed out, its indirect influence is an important factor.

Cleveland

Business in the machinery and machine tool market has shown improvement in the past fortnight. Orders placed were mostly for small pieces of special design. Inquiries are more plentiful and it is the general belief in the trade that business will continue at an even gait in the next few months. The total volume of sales for February were somewhat disappointing but increased buying during the first week of March has restored confidence.

Manufacturers of planers, automatic cranes and metal-working machinery have received a fair amount of orders.

The Cleveland Heights Board of Education is preparing its list of tools for the new high school.

Detroit

Orders for machinery and machine tools continue to pile into the offices of the Detroit dealers at a rate which will make the first quarter of 1926 far ahead of the same period last year.

In automotive circles there is either a lot of buying or else none at all. With production figures reaching unheard-of figures, and many of the leaders engaging in the most spirited race in history to capture the favor of the public, engineers are busy with plans for further reductions in cost.

There is everywhere manifested a desire to supplant antiquated machinery with up-to-date equipment. Packard can be cited as one excellent example, as Packard engineers have been able to so arrange some departments as to cut down half in machinery space while at the same time increasing the output, all because of installation of modern equipment.

Several of the plants are revamping their cylinder finishing lines. A number of machinery firms report orders for new equipment for this work.

Among the more active buyers just at present are the Ford Motor Co., the Wilson Machine and Foundry Co., Packard and Buick.

Railroads in Detroit are in the market for several lists of equipment, especially the Michigan Central and Pere Marquette.

Employment has broken all figures again, with 271,927 at work in the motor car and accessory plants of Detroit.

Southern District

Though the principal volume of business the past two weeks has been in small tools and equipment, there is also a slight upward movement in heavier tool sales, with salesmen covering the Southern district reporting the outlook as promising steady betterment during the last half of March.

Garage equipment has picked up the last two or three weeks, and sales now are about normal for this time of year. Most sales reported are for used or rebuilt equipment. Replacement parts are unusually active, and jobbers look for 1926 to exceed 1925, though last year was the largest in the history of the business.

Sawmill, planing mill and woodworking machinery have been particularly active the past month, one of the larger Atlanta distributors reporting February sales the biggest in the history of his business.

Railroad inquiries are active and though some improvement is seen in sales they are not yet on a particularly heavy basis, about even with last year's business at this time. Most of the inquiries are for heavier machinery or tools.

Tractor and power farming equipment sales continue to exceed those of the corresponding period in 1925, and with the agricultural industry in a generally prosperous condition in the Southeast because of last year's heavy cotton crop and the high prices prevailing, there is promise that 1926 will witness as heavy a volume as last year.

Sales to smaller shops are quiet, with nearly all of the demand for used or rebuilt equipment.

Road-building equipment and contractors' equipment are both picking up steadily, and with another big construction year in promise March should prove a particularly good month.

Chicago

Machine tool business thus far in March is about on a par with that transacted during the last half of February. Dealers specializing in used machinery, while they are not what might be termed enthusiastic regarding present market conditions, are uniformly expectant of increased sales as the month progresses, inquiries being satisfactory in number and covering most lines of machine tools in general use. Used tools are in good demand, but the prices offered are, in the main, lower than dealers have been accustomed to receiving, and as a consequence an effort is not being made to push sales.

Manufacturers of some lines of special machinery continue to find an excellent demand for their products, the local representative of one Eastern concern reporting that the months of January and February this year showed up better in point of sales than for several years past, and that the first week in March has kept well up to the average. This demand comes from general industries, not from any particular one.

The automotive industry still heads the list of buyers for general lines of tools. Railroad inquiries are being received for small lots for tools to fill out shop equipment, but none of the lists issued have been closed up to this time.

New England

More business in special machinery manufacturing is offered than can be handled in certain sections of the New England territory. Production is in increased volume, working schedules being extended 25 per cent and working forces in plants showing gains of 15 to 35 per cent. Manufacturers state that with no new orders forthcoming plants could continue to operate on the present schedules from four to six months.

Small tool machinery business is improving. Manufacturers of lines for the automobile trade is better and machine tools and small tools are also improved. Builders of drilling machines and punch presses are coming out of a period of dullness that prevailed for the past three months. Orders are being placed and inquiries are better. The outlook for the next two months is bright.

Philadelphia

An increase in the volume of orders and inquiries has been noted in Philadelphia industrial centers during the past two weeks. Manufacturers who a month ago complained of the failure of the machine tool business to respond to the general industrial advancement, this week asserted their volume of inquiries had shown a marked increase, and the number of orders developing from such inquiries has been encouraging.

Indications from the offices of most of the larger dealers and producers are for a busy period during the next three or four months. It was admitted that conditions may shift in such a way as to prevent this being realized, but buying now appears to be on the increase. Most of the larger Philadelphia manufacturing plants are operating from 40 to 60 per cent of capacity, with indications that this will increase shortly.

The railroad companies in the Philadelphia area do not show a tendency to resume machine tool buying on anything but a hand-to-mouth scale.

New York

With the first half of March just finished, business in machinery and machine tools has picked up. Special machinery is in good demand, many large industrials making purchases of high production tools for performing some particular work. These orders are rarely for more than one or two pieces, but they are numerous enough to afford a comfortable volume of business.

Much is expected from the railroads in the next few months. Surplus funds carried over from last year and larger appropriations for new equipment will soon be released, and most dealers in this territory believe that this will be one of the best railroad buying years in a long time.

The first quarter of 1926 shows more business done than in the same period last year and the general conditions affecting this industry are such that the second quarter will undoubtedly be better than the first, when total sales are compared.

New Aircraft Venture Started in Detroit

Detroit's progress in the aircraft industry has been furthered with the successful public test flight of a new plane designed by Edison Stinson, and the announcement of plans to establish a manufacturing plant there immediately.

The new plane, the "Stinson-Detroiter," was flown formally for the first time at Packard Field, Feb. 21. In design and construction the craft embodies many improvements, which Mr. Stinson has built out of his experience of 14 years of flying. The plane is of the biplane type with four-place enclosed cabin.

The motor used is a 200-horsepower Wright Whirlwind, equipped with a Bijur self-starter. This latter innovation does away with the need of a mechanic to whirl the propeller when it is desired to start the motor.

The plane has a top speed of about 125 miles an hour. Its cruising speed is about 105 miles an hour, and it can cruise for about five hours, or 500 miles. Empty, the plane weighs 1,700 lb., and is designed to carry 1,200 lb. pay load. Gas capacity is 76 gallons, and oil capacity eight gallons.

The plane has a wing spread of 35 ft. and is 28 ft. from propeller tip to tail. The cabin provides space for pilot and three passengers. A baggage compartment sufficient for baggage for all four is provided behind the rear seat.

The landing wheels are equipped with brakes operating independently, which allows the pilot to taxi the plane about a field without mechanics to guide its course.

Fire Destroys Nickel Plate Repair Shops

Fire on March 9 virtually destroyed the locomotive shops of the Nickel Plate Railroad at Frankfort, Ind., with a loss of $50,000. Several hundred men will be temporarily out of work. The fire started when an oil burner in the roundhouse exploded. The roundhouse, the machine shops, blacksmith shops, a quantity of new machinery and a number of locomotives were damaged before the blaze burned itself out.

What the Railroads Are Doing

The plants of the American Locomotive Co. operated on a smaller scale last year than in any other year since the organization of the company in 1901, according to W. H. Woodin, president. This was due to the lack of orders for locomotives for both domestic and foreign account, according to the annual report to stockholders. The statement showed a loss from operations, compared with substantial profits reported in the two previous years.

The detailed income account for 1925 shows gross earnings of $27,773,493 against $56,301,843 in 1924, and a net operating loss of $843,321, before preferred dividends requirements, against an operating profit of $6,649,507 in 1924.

Mr. Woodin calls attention to the numerous developments in the locomotive business which "will give maximum power with a minimum of fuel and maintenance expense." He also reviews the developments in the oil electric locomotive, saying the company has already built four of these engines and now has sixteen under construction. He concludes by asserting that "there is now every indication that the locomotive business will show a substantial improvement during the coming year."

An extensive improvement program which is expected to lower operating costs and increase net earnings is planned by the Chicago & North Western Ry., according to President Sargent.

The plan provides for construction of mechanical coal chutes at different points, building of additional water plants, construction of longer passing tracks and strengthening of bridges.

"We are installing electrical machinery in our machine shops and putting in new devices in these shops," Mr. Sargent said. "We are operating our passenger locomotives through without change between Chicago and Minneapolis and between Minneapolis and Sioux City. We have just contracted for purchase of three additional gasoline electric locomotives for use on our branch lines."

The American Locomotive Co. in the last week has closed contracts for twenty-three locomotives for the Southern Pacific R.R. and twenty-three locomotives for the Florida East Coast R.R. These two contracts are valued at approximately $4,000,000 and gives the company a total of $22,000,000 unfinished business on its books. This total compares with total sales of $27,773,493 reported for 1924.

The Baldwin Locomotive Works announced last week that it had received orders for twenty-nine locomotives from the Southern Railway and seven from the Southern Pacific. The Southern Railway placed orders a week ago for eighty-four locomotives and the Southern Pacific for twenty-three engines with the American Locomotive Co. These additions make total contracts from the Southern Railway for 133 and from the Southern Pacific for thirty.

In addition to the inquiries placed in the open market last week by the Pennsylvania Railroad it is reported that the road may construct 100 locomotives in its shops at Altoona, Pa.

News of the Automotive Industry

Automobile production in February was 364,618 cars and trucks according to National Automobile Chamber of Commerce preliminary estimate. This compares with production of 314,994 vehicles in January and 287,213 in February, 1925.

According to the *Boersen Zeitung* a new anti-knock motor fuel has just been brought on the market by the Hugo Stinnes Oil Aktiengesellschaft of Berlin, states a report to the Department of Commerce. A fraction of a percentage of this substance, combined with ordinary gasoline, is said effectually to prevent knocking in motors or the formation of carbon.

The Reo Motor Car Co. claims to have the lowest labor turnover in the automotive industry. For 1925 it was 21.8 per cent, which is considered especially low in view of the greater than normal demand for men which existed in and around Lansing during the year, and the fact that it was Reo's biggest production year.

According to recent press reports the General Motors Co. has organized a subsidiary under the French laws. The charter of the company will expire in 2015. Its capitalization consists of 1,000 shares of 1,000 francs per value, or a total of 1,000,000 francs. The directors of the new company, which is known as the General Motors of France, include James Mooney of New York, Homer Zimmermann of Copenhagen, Paul Baergin and William Thomas Whalen of Antwerp, and Morris Kerr Clark of Paris.

"The outlook for automobile accessory business is about the same as this time last year, with indications pointing to steady demand for the first six months," says C. W. Stiger, president of Stromberg Carburetor Co. "It is rather difficult to say at this time, without guessing what the last half of the year will bring forth." Mr. Stiger says he does not believe demand for American automobiles from foreign countries will continue to be as large as last year. Foreign manufacturers are commencing to make cars similar to American types and are reducing prices in an effort to get business.

The import duty on motorcycles in Sweden has been changed from 60 crowns each to 15 per cent ad valorem, according to a cablegram received in the Department of Commerce.

Personals

H. C. MERRITT has been appointed manager of the tractor division of the Allis-Chalmers Manufacturing Co., of Milwaukee.

MANUEL GRANICH has joined the New York office of the Foote Bros. Gear and Machine Co., of Chicago, as sales engineer.

K. H. CRUMRINE has become associated with the National Acme Co., of Cleveland. He was formerly sales engineer for the Cincinnati Shaper Co.

W. L. MILNOR and W. C. DARUGH have been added to the sales force of the Philadelphia office of the Foote Bros. Gear and Machine Co., of Chicago.

GEORGE K. BURGESS, director of the Bureau of Standards, is in Williamsport, Pa., to confer with the members of the American Society of Mechanical Engineers.

HERBERT A. DAVIES, manager of the Memphis office of the Virginia Bridge and Iron Co., has been appointed manager of the company's plant at Birmingham, Ala.

WILLIAM A. EDWARDS, manager of the Chicago territory for the Ludlum Steel Co., of Watervliet, N. Y., has been transferred to Houston, Texas, in charge of the Southwestern territory.

H. T. THOMAS, vice-president and chief engineer of the Reo Motor Car Co., has retired after many years service with the company. F. Segardi is now in charge of engineering work.

VICTOR GOTTSMAN has left the Motch & Merryweather Machinery Co., of Detroit, where he has been employed as a salesman and is now connected with the Wolverine Machinery Co.

JOHN V. CALHOUN has become sales manager for Harold E. Trent, manufacturer of electrical heating and control appliances, of Philadelphia. He was formerly engineer with the Combustion Engineering Corporation.

CHARLES E. BARBA, formerly superintendent of the Osgood Bradley Co., of Worcester, Mass., has been appointed mechanical engineer for the Boston & Maine R.R. Walter Weissinger has succeeded him as superintendent of the Osgood Bradley company plants.

FRANK R. SCHUBERT has been appointed vice-president of the McGill Metal Co., Valparaiso, Ind., manufacturers of aluminum bronze die castings. Mr. Schubert was at one time connected with the Strom Ball Bearing interests in Chicago, having been works manager when the company was known as the U. S. Ball Bearing Manufacturing Co. When the Strom plant was sold to the Marlin-Rockwell Corporation, Mr. Schubert continued with the new organization as division manager until he resigned in January.

Business Items

The Empire Machinery Exchange, of Cleveland, has opened a new warehouse on Columbus Road, that city.

The Cruban Machine and Steel Corporation announces its removal to 54 Varick St., New York City.

The Curle Manufacturing Co. announces the removal of its plant and offices to 543 Howard St., San Francisco, California.

David A. Wright, Inc., announces that it will remove from its present quarters on May 1, to its warehouse, W. Roosevelt Road and Washtenaw Ave., Chicago.

Announcement is made of the purchase by the Black & Decker Manufacturing Co., Towson, Md., of the plant of the Marschke Manufacturing Co., of Indianapolis.

The Air Reduction Co., of New York, elected all its regular officers at the annual meeting last week. Mathew C. Brush and Robert K. Cassatt were added to the board of directors.

The Challenge Cutlery Corporation, of Bridgeport, Conn., manufacturer of shears, razors and knives, is to terminate its business within the next two or three months. The company's property, including plant equipment, a three-story factory building and, is being offered for sale.

With the construction of additional factory buildings, the Warner Gear Co., of Muncie, Ind., plans enlarging production. The buildings will cost several hundred thousand dollars and the force increased to about 1,400 employees. The buildings will be completed within two months and machinery will be installed by the last of May.

Henry Disston & Sons, Inc., have opened a new service branch and warehouse in Detroit. Complete stock will be carried of electro-crucible high-speed steel, carbon tool steels, and special alloy steels. Bandsaws and circular saws for wood and metal, hacksaws, files and machine knives will also be stocked.

The Bridgeport Brass Co., of Bridgeport, Conn., announces the election to the board of directors of Warren B. Blatz, general works manager, and Walter R. Clark, general sales manager. This promotion is in line with the company's policy of according the employees representation in the management of the organization.

The Stanley Works, of New Britain, Conn., has purchased the Frederick Carl von Bruck plant at Velbert, Rhineland, in the Ruhr district, Germany. The plant employs 500 hands and manufactures hinges, bolts, castors and the like. An option on a plant in Belgium has been allowed to lapse. John E. Cairs, formerly of Waterbury, Conn., is in charge.

The G. M. Diehl Machine Works, at Wabash, Ind., will increase its factory and offices. The company manufactures rip saws, continuous feed glue joiners and wood-working machinery. Approximately 10,000 sq.ft. will be added to the floor space. The new wing will be used as an assembly department. Additional space will be provided for the drafting and engineering departments. New machinery will be installed, each machine to be equipped with an individual motor.

Lee & Clark, Inc., has been organized in Chicago to take over the business of the James T. Lee Co. Offices are maintained at 549 W. Washington Blvd., and the new company will continue to specialize in hydraulic equipment, plate working tools, metal-working machinery and similar tools. James T. Lee, formerly vice-president of the Hanna Engineering Works, is president of the new company. John O. Clark, formerly sales manager of the Hanna company, is vice-president.

Stockholders of the Graton & Knight Manufacturing Co., of Worcester, Mass., have approved the plans for reorganization as formulated by the directors of the company. The concern, manufacturer of leather belting, will be known in the future as the Graton & Knight Corporation. It is capitalized for $2,500,000. The officers of the new organization follow: Frank H. Willard, president; Charles A. Bartlett, treasurer; Stanley G. Barker, secretary. The directors are: Frank H. Willard, John E. White, Paul B. Morgan, Harry G. Stoddard, Homer Gage and J. Verner Critchley, all of Worcester; Stanley A. Russell, New York; W. Virgil Spaulding, Pasadena; and George S. Armstrong, of New York.

Reorganization of the Fenton Tool and Die Co., at Fenton, Mich., whose products are taken largely by automobile factories, has been approved by the stockholders and directors. In the reorganization Almar Westman will retire and his interests will be acquired by Joseph Day, Detroit representative of the company for several years. Mr. Westman, who left the company March 1, has formed a partnership with James Edwards and Neal Palmer, of Flint, who were formerly with the Dort Motor Car Co. They will engage in purchasing used factory machines, putting them through a remodeling and repairing process and selling them again. The new firm will be known as the Industrial Machine Tool Co.

The Dodge Manufacturing Corporation, of Mishawaka, Ind., has taken over the entire business and personnel of the Hugh P. Robbins organization of Chicago, and has created a new division of its general sales and engineering departments to be known as the Material Handling Division. This action on the part of the Dodge organization is in line with the policy of expanding the material handling department. Hugh P. Robbins now heads this division, and he has at his disposal a thoroughly organized personnel of experienced engineering specialists. The Dodge Manufacturing Corporation recently announced a complete new line of plain bearing belt conveyor idlers, as well as a Dodge-Timken roller bearing conveyor idler.

Trade Catalogs

Gears. Grant Gear Works, 2nd and B Sts., South Boston, Mass. A catalog and price list has been published by this company containing lists of iron and brass cut gears, cast gears and wheels made or cut to order.

Worm reduction gears, sprockets, chains and racks are also described and listed. A considerable number of information tables and drawings are appended as well as directions for drawing various types of gears.

Flanging Machines. Morey, Jones & Lovell, 810 West Sixth St., Los Angeles, Calif. Bulletin No. 22 describes the Sievert adjustable flanging machines. Specifications are given as well as an illustrated description of the purpose, construction and operation of the machines. Power and hand types are illustrated in the bulletin.

Industrial Furnaces. The Chicago Flexible Shaft Co., 1156 South Central Ave., Chicago, Ill., has published a folder on its Stewart industrial furnaces and pressed-steel pots. Various models are illustrated and briefly described.

Stokers. Detroit Stoker Co., General Motors Bldg., Detroit, Mich. Detroit multiple-retort underfeed stokers are described in bulletin No. 130, containing twenty-four, 8½x11-in. pages. Many illustrations are included to bring out such features as the level fuel bed and the method for controlling the movement of the fuel during combustion. Details of the stoker are shown and many photographs of installations are included in the bulletin.

Straightening Machines. Kane & Roach, Syracuse, N. Y., have issued bulletins Nos. 52, 53, 57 and 58 included in a binder. The bulletins describe various types of straightening machines for handling wire, rod, strips and sheets. Many illustrations show details of the standard and special machines, and the rolls used. Photographs of several installations are included in each bulletin. The descriptions of the machines are well prepared and complete specifications are given.

Calendar of Local Meetings

National Association of Cost Accountants

Chicago. March 18. "Merchandise Control in the Retail Establishment."

Milwaukee. March 19. "Mechanical Devices for Cost Work."

San Francisco. March 22. Discussion of the subject—"The Cost to Sell."

Scranton. March 23. "Depreciation," Mr. Griesmann.

Boston. March 25. "The Elements of Standard Cost," by R. D. Willard.

American Society for Steel Treating

Hartford. June. Spring sectional meeting.

Society of Automotive Engineers

Detroit Section. March 25. Production meeting on automobile gearing.

Chicago. March 26. "Development and Trend in Industry," by F. E. Moskovics. Other discussions by H. L. Horning, and R. E. Wilson.

Northern California. March 26. "Gasoline and New Fuel Tests," by W. S. Jones.

American Society of Mechanical Engineers

Cleveland. March 23. Hotel Winton, joint meeting of A. S. M. E., A. S. C. E., and S. I. E. Speaker, W. D. Collins, U. S. Geological Survey, Washington, D. C.

Metropolitan. March 24. Engineering Societies Bldg., joint meeting with student branches. Subject: "Opportunities for Engineers in Industry," by James O. G. Gibbons.

Cincinnati. March 26. English Literary Club rooms. Subject: "Artificial and Natural Gas," by H. C. Blackwell.

Colorado. March 26. Metropole Hotel. Subject: "Reclamation Service," by W. C. Day.

St. Louis. March 26. Warwick Hotel. Subject: "Men and Methods," by Col. Fred C. Green.

St. Paul. March 26. St. Paul Auditorium. Speaker, J. E. Haynes, of the Government Museum, Yellowstone National Park.

New England Meeting. May 3 to 6. Providence, R. I. Chairman of program committee, Luther D. Burlingame.

Forthcoming Meetings

National Metal Trades Association. Twenty-eighth annual convention, Hotel Astor, New York, April 15 and 16. Secretary, J. E. Nyhan, Peoples Gas Bldg., Chicago, Ill.

American Welding Society. Annual meeting, Engineering Societies Bldg., New York City, April 21, 22 and 23.

National Foreign Trade Council. Thirteenth national foreign trade convention, Charleston, S. C., April 28, 29 and 30. O. K. Davis, secretary, India House, Hanover Square, New York.

American Gear Manufacturers' Association. Tenth annual meeting, Book-Cadillac Hotel, Detroit, May 13, 14 and 15. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Supply and Machinery Manufacturers' Association. Annual convention, Hotel Statler, St. Louis, week of May 17. F. D. Mitchell, secretary, 1819 Broadway, New York.

Society of Automotive Engineers. Summer meeting, French Lick Springs, Indiana, June 1 to 4. John Warner, manager of meetings, S. A. E., 29 West 29th St., New York City.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Railway Association. Annual meeting of the Mechanical Division (Master Car Builders and Master Mechanics), Atlantic City, N. J., June 9 to 16. V. R. Hawthorne, secretary, 431 So. Dearborn St., Chicago.

Railway Supply Manufacturers' Association. Annual convention and exhibit in conjunction with Division V, Mechanical, of the American Railway Association, Young's Million Dollar Pier, Atlantic City, June 9 to 16. J. D. Conway, secretary, 1841 Oliver Bldg., Pittsburgh.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials. Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under the auspices of the American Foundrymen's Association. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel.—The downward trend in coke prices which might be expected to result in easier pig-iron quotations, is offset by a rising tendency in iron ore; little actual change, however, occurred during the past week. Steel prices also remain steady with some prospects of increased demand in structurals, pipe, sheets, tin plate, automotive and railway equipment and supplies. Mill quotations are: bars, $2; shapes, $1.90@$2; plates, $1.80@$1.90 per 100 lb., Pittsburgh.

Non-Ferrous Materials.—Copper is up ⅛c. per lb. at New York warehouses, compared with the level of Mar. 5. Lead and solder are down ⅛c., zinc and No. 4 babbitt, ¼c. per lb.; other materials remain firm.

(*All prices as of Mar.* 13)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.27
Basic	22.27
Bessemer	22.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.45@2.50	3.89	3.25	3.50
No. 12	2.50@2.55	3.94	3.30	3.55
No. 14	2.55@2.60	3.99	3.35	3.60
No. 16	2.65@2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.00@3.15	4.30	3.90	3.90
Nos. 22 to 24	3.05@3.20	4.35	3.95	3.95
Nos. 26 and 27	3.10@3.25	4.40	4.00	4.00
No. 28	3.20@3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.50@3.60	4.50	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.60	4.35	4.35
No. 16	3.75@3.85	4.75	4.50	4.50
Nos. 18 to 20	3.90@4.00	4.90	4.65	4.65
Nos. 22 to 24	4.05@4.15	5.05	4.85	4.80
Nos. 26 and 27	4.20@4.30	5.20	5.10	4.95
No. 28	4.50@4.60	5.50	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches External	Diameter in Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness Decimal Fractions	B.W.G. and Fractions	Outside Diameter in Inches ⅛	¼	⅜	½	1	1½	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	50@60%	55%	50%

Electric welding wire, New York, 5/32, 8.25c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb. *Flat, 1/16@⅛-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.37½
Tin, 5-ton lots, New York			65.50
Lead (up to carlots) E. St. Louis	8.15	New York	9.25
Zinc (up to carlots) E. St. Louis	7.32½	New York	8.25

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	22.00	24.50	26.00
Copper sheets, base	22.75	22.75	22.75
Copper wire, base	19.50	16.50	16½@16½
Copper bars, base	22.37½	22.37½	22.37½
Copper tubing, base	24.50	24.50	24.50
Brass sheets, base	19.12½	19.12½	19.12½
Brass tubing, base	23.75	23.75	23.25
Brass rods, base	16.87½	16.87½	16.87½
Brass wire, base	19.62½	19.62½	19.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.25	41.00	38@42

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	81.50
Commercial genuine, intermediate grade	56.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	14.25

Nickel, f.o.b. refinery, cents per lb.:

Ingots	31.00	Electrolytic	38.00
Shot			32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.25@12.50	11.25	11.50@12.00
Copper, heavy, and wire	11.50@12.00	11.50	11.00@11.50
Copper, light, and bottoms	9.75@10.25	9.50	10.00@10.50
Heavy lead	7.62½@ 7.87½	7.50	7.25@ 7.75
Tea lead	5.50@ 5.75	5.00	6.25@ 6.75
Brass, heavy, yellow	7.25@ 7.50	7.25	7.75@ 8.25
Brass, heavy, red	9.50@10.00	9.50	8.75@ 9.25
Brass, light	6.00@ 6.50	6.00	7.25@ 7.75
No. 1 yellow rod turnings	8.50@ 9.00	8.00	7.75@ 8.25
Zinc	4.50@ 4.75	4.75	4.50@ 5.00

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade: IC,	14x20	$11.25	$11.45	$11.50
"A" Grade: IC,	14x20	8.85	9.40	9.50
Coke Plates—Primes—Per box 100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box IC,	14x20	7.85	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@ .15½	.10	.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.25	2.25	2.75*
Roll sulphur, per 100 lb.	3.75	3.35	5.00
Linseed oil, per gal., 5 bbl. lots	.83½	.99	.85
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.1687½	.1662½	.1762½
Solder (½ and ½)	per lb.	.4025	.3925	.42
Cotton waste	per lb.	.15@.22	.15@.22	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.60
Machine oil	per gal.	.35	.35	.33
Belting, leather, medium	off list	40–5%	40–5%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.00@ 3.25
Coke, prompt foundry, Connellsville	per net ton		4.50@ 5.50
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ½-in. and larger.
Case hardened ½x½-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ⅞-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ¾-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅝-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ga., Statesboro—The Savannah & Statesboro Ry. Co., D. C. Smith, Gen. Mgr.—lathe, shaper, drill press and small machines and tools for proposed 1 story, 70x90 ft. shop to replace fire loss.

Mass., Boston—G. W. Connelly, 14 Atlantic Ave.—14 or 16, 6 x 8 bed lathe with compound and taper attachment.

Mass., Boston—Gerard Electric Co., 92 Pearl St.—screw cutting lathe.

Mass., Cambridge (Boston P. O.)—C. J. Cox Engineering Co., Putnam Ave.—4 to 8 ft. sheet metal squaring shear.

Mich., Detroit—A. & G. Tool & Die Co., 1052 Morrell St.—drill press and shaper for machine shop.

N. Y., Cuba—C. B. Hedges—tools and equipment including lathe, drill, etc., for proposed auto repair shop and service station. Estimated cost $45,000.

N. Y., New York—National Iron Pipe & Supply Co., 97 Wooster St.—Hendey engine lathe 24 in. swing about 10 ft. bed.

N. Y., New York—Novo Tool Corp., 758 Whitlock Ave., W. A. Novating, Purch. Agt.—punch press geared about 30 in. between 4 to 6 in. stroke.

O., Cleveland—Wheeling & Lake Erie Ry. Co., W. W. Griswold, Purch. Agt.—two 20 in. x 8 ft. heavy duty engine lathes and two 28 in. back geared shapers.

Pa., Verona—Woodings Forge & Tool Co. 400 to 500 ton power press.

Que., Montreal—Dawson & North Pattern & Model Works, 130 Queen St.—pattern and machine shop equipment.

Australia—Melbourne-Victorian Government Railways, will receive bids until April 16 for 1 horizontal boring, surfacing and milling machine including motor starting apparatus, tool equipment and accessories.

Opportunities for Future Business

Calif., Fresno—Fresno county, D. M. Barnwell, Clk., will receive bids until April 6 for the construction of a 1 story, 100 x 100 ft. garage and equipment maintenance shop at Chance and Butler Aves.

Calif., Mountain View—Mountain View High and Grammar School Districts, plan an election to vote $55,000 for construction of high school, shops and gymnasium.

Calif., Pasadena — Southern California Edison Co., Edison Bldg., Los Angeles, will build a 1 story, 85 x 100 ft. garage and warehouse at Logan and Hammond Sts., here. Private plans.

Calif., San Francisco—A. Madsen, 752 Bryant St., awarded contract for the construction of a 1 story machine shop on Perry St. Estimated cost $6,500.

Conn., Bridgeport—The Housatonic Machine & Tool Co., Staples St., awarded contract for the construction of a 40 x 45 ft. addition to factory.

Conn., Bridgeport—Mack Motor Co., 673 Connecticut Ave., awarded general contract for the construction of a 1 story, 175 x 196 ft. garage and service station at Ash Creek. Estimated cost $150,000. Noted Jan. 28.

Conn., Thomaston—Seth Thomas Clock Co. had plans prepared for the construction of a 25 x 35 ft. heat treating building. Buck & Sheldon, Inc., 60 Prospect St., Hartford, Engrs.

Ind., Frankford—New York, Chicago & St. Louis R.R. Co., Prospect Ave. and East 2nd St., Cleveland, O., Nickel Plate Dist., new locomotive shops, including machine and blacksmith shops, etc. were destroyed by fire, loss is estimated at $1,000,000. A. C. Harvey, Ch. Engr.

Ind., Indianapolis—Indianapolis Power & Heat Co., Monument St., W. C. Marmon, Pres., plans the construction of a 1 story garage, etc., at Morris St. and Belt Ry. Estimated cost $200,000.

Ia., Marshalltown—Fisher Governor Co., manufacturers of steam specialties and milling machines, awarded contract for the construction of a 1 story, 60 x 60 ft. factory. Estimated cost $40,000. Noted Mar. 4.

Mass., Boston—Shikes, Long & Waldron, 18 Tremont St., is having plans prepared for the construction of a 2 story repair and service garage on Worcester St. Estimated cost $50,000. S. S. Eisenberg, 46 Cornhill, Archt.

Every one of these items is reported by our authorized correspondents who are instructed to verify every item sent in. This free weekly service is published in the interests of the buyer and the seller, to bring them together and get machinery moving.

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BUSINESS NEWS DEPARTMENT
Tenth Ave. at 36th St., New York

Mass., Boston—Y. D. Garages, Inc., 341 Newbury St., lessee, is having plans prepared for the construction of a garage on Elliot St. Estimated cost $200,000. Krokyn & Doane, 162 Newbury St., Archts.

Mass., Salem—City plans the construction of a garage on Howard St. Estimated cost $150,000. Architect not selected.

Mich., Detroit—Cadillac Motor Car Co., Clark Ave., awarded contract for the construction of a 60 x 275 ft. garage. Noted Feb. 11.

Mich., Detroit — Detroit Stove Works, East Jefferson Ave., plans the construction of a 2 story, 82 x 174 ft. addition. Estimated cost $50,000.

Mich., Highland Park (Detroit P. O.) — Huggins Tool Co., 258 West Congress St., Detroit, is receiving bids for the construction of a 1 story, 110 x 120 ft. assembly plant here. Estimated cost $50,000. R. A. Bailey, 92 Peterboro St., Detroit, Archt.

Mich., Sault Sainte Marie—County Road Commissioners awarded contract for the construction of a 1 story, 72 x 100 ft. machine shop.

Neb., Hastings—N. Harrenstein, plans an election March 9 to vote $450,000 bonds for additions to high school including shops, etc. H. K. Geding & Co., Loyal Mystic Legion Bldg., Archts.

N. J., Elizabeth—Lidgerwood Mfg. Co., 96 Liberty St., New York, N. Y., will build a shop and foundry here. Architect not selected.

N. Y., Albany—J. Braun, 29 Hamilton St., is having plans prepared for the construction of a 2 story garage. Estimated cost $150,000. O. Goldschlag, 1428 Broadway, New York, Archt.

O., Cincinnati—Boye & Emmes Machine Tool Co., F. W. Boye, Jr., Pres. and Treas., 2245 Spring Grove Ave., awarded contract for the construction of a 1 story, 90 x 300 ft. factory on Queen City Ave. Estimated cost $150,000.

O., Cleveland—The Domestic Electric Co., R. J. Lamb, Secy., 7209 St. Clair Ave., is having plans prepared for the construction of a 2 story, 40 x 140 ft. addition to factory. Estimated cost $50,000. W. J. Wefel, 5716 Euclid Ave., Archt.

O., Cleveland—Rickersberg Brass Co., S. L. Rickersberg, Secy. and Treas., East 37th St. and Perkins Ave., plans the construction of a factory. Estimated cost $150,000. Christian, Schwarzenberg & Galda, 1900 Euclid Bldg., Archts.

O., Cleveland—The Studebaker Corp. of America, E. R. Parker, Sales Mgr., 2000 Euclid Ave., will soon award contract for the construction of a 1 story, 105 x 194 ft. auto sales and service station at West 117th St. and Clifton Blvd. Estimated cost $150,000. W. S. Ferguson Co., 1900 Euclid Ave., Archt.

O., Columbus—State Street Office Building Co., W. E. Schwartz, Pres., had plans prepared for the construction of a 5 story, 87 x 158 ft. garage and office building on East State St. Estimated cost $650,000. Architectural Service Co., 163½ North High St., Archt.

O., East Cleveland (Cleveland P. O.)—The Barnes Motor Co., (Dodge Bros. Agency) W. P. Barnes, Pres., 1938 East 21st St., plans the construction of a 2 story auto sales and service building at Euclid Ave. and Ivanhoe Road. Estimated cost $150,000. Architect not selected.

Pa., Nazareth—Bates Valve Bag Co. plans the construction of a 1 story, 100 x 160 ft. factory. Estimated cost $40,000. Architect not selected.

Pa., Philadelphia—The H. W. Butterworth & Sons Co., York and Cedar Sts., manufacturers of machinery and parts, awarded contract for the construction of a 1 story addition to factory. Estimated cost $17,000.

Pa., Pittsburgh — McKee Oliver, Inc., Oliver Bldg., awarded contract for the construction of a 1 story, 100 x 200 ft. steel plant on West Carson St. Estimated cost $40,000.

R. I., Providence—Liberty Tool & Gauge Works, 338 Bernon St., Woonsocket, awarded contract for the construction of a 1 story, 80 x 120 ft. factory on Toronto Ave., here. Estimated cost $40,000.

Wis., Manitowoc — Wastman Mfg. Co., North 11th St., manufacturers of hose couplings, is having plans prepared for the construction of a 2 story, 50 x 100 ft. addition to factory. Smith & Brandt, Dempsey Bldg., Archts.

Wis., North Fond du Lac (Fond du Lac P. O.)—J. E. Burke, 341 North Park Ave., manufacturers of metal weather strips, awarded contract for the construction of a 1 story, 44 x 100 ft. factory. Estimated cost $40,000.